Enabling the Market: Incentives for Biodiversity in the Rangelands:

Report to the Australian Government Department of the Environment and Water Resources
by the Desert Knowledge Cooperative Research Centre

Anita Smyth

Anthea Coggan

Famiza Yunus

Russell Gorddard

Stuart Whitten

Jocelyn Davies

Nic Gambold

Jo Maloney

Rodney Edwards

Rob Brandle

Mike Fleming

John Read

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Department of the Environment and Water Resources

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Contributing author information

Anita Smyth: CSIRO Sustainable Ecosystems

Anthea Coggan: CSIRO Sustainable Ecosystems

Famiza Yunus: CSIRO Sustainable Ecosystems

Russell Gorddard: CSIRO Sustainable Ecosystems

Stuart Whitten: CSIRO Sustainable Ecosystems

Jocelyn Davies: CSIRO Sustainable Ecosystems

Nic Gambold: Central Land Council

Jo Maloney

Rodney Edwards: Ngaanyatjarra Council

Rob Brandle: South Austalia Department for Environment and Heritage

Mike Fleming: South Australia Department of Water, Land and Biodiversity Conservation

John Read: BHP Billiton

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The Desert Knowledge Cooperative Research Centre is an unincorporated joint venture with 28 partners whose mission is to develop and disseminate an understanding of sustainable living in remote desert environments, deliver enduring regional economies and livelihoods based on Desert Knowledge, and create the networks to market this knowledge in other desert lands.

For additional information please contact

Department of the Environment and Water Resources
Assistant Director, Biodiversity Trends Section
GPO Box 787
CANBERRA ACT 2601
Phone: (02) 02 6274 1111

Copies may be downloaded from <http://www.environment.gov.au/about/publications/index.html>

Foreword

In December 2004, the Desert Knowledge Cooperative Research Centre (DKCRC) funded a scoping study on a potential set of integrated tools for auditing biodiversity, assessing biodiversity condition, and exploring the feasibility of reward or incentive schemes for ecologically sustainable outcomes in the South Australian rangelands (i.e. DKCRC project 1.707 Rewards for biodiversity). The research consortium for this project comprised CSIRO, South Australia's Department of Water, Land and Biodiversity Conservation (SADWLBC), South Australia's Department for Environment and Heritage (SADEH), environmental scientists responsible for managing BHP Billiton's pastoral holdings, and a postgraduate student from The University of Adelaide. The research was based on a case study approach and we used the Stony Plains bioregion as the study area. We performed desktop and participatory studies to report on biodiversity assessment tools for the Stony Plains bioregion.

In August 2005, the Australian Government Department of the Environment and Heritage (now Department of the Environment and Water Resources) commissioned the DKCRC to inform department decisions about market-based incentives for achieving biodiversity conservation outcomes in the rangelands. The title of the commission was 'Enabling the market: incentives for biodiversity in the rangelands' (DKCRC project 1.806). It had a whole-of-rangeland focus and it specifically targeted information on market-based incentives.

The motivation for this study was largely driven by the large body of work on conservation incentive programs for biodiversity conservation on private lands in the intensive land use zone of coastal Australia. The extensively managed rangelands which cover some 80% of the continent have received little investment largely because the landscapes are perceived to be relatively intact. However, recent State of the Environment reports suggest that rangeland ecosystems are in slow decline and extremely vulnerable to inappropriate land uses, fire management practices and invasive weed species. Biodiversity conservation options in the rangelands are likely to be highly cost-effective and could alleviate the need for large remedial investments in the future. Because their has been less exposure for market-based delivery of conservation outcomes in the rangelands than in the intensive land use zone, it is unknown how transferable they are; this must be understood before embarking on any new investments.

The expected outcomes of this study were:

- The scientific basis necessary to support the development of a market-based approach to biodiversity conservation in the rangelands
- A better understanding for investors of the depth of any potential incentives markets
- Improved regional and organisational ability to plan for and implement incentives programs to protect biodiversity.

Research outputs were:

1. a field-tested condition/intervention metric for rangeland Australia, where the metric is applied in incentive policies to summarise future management outcomes for biodiversity conservation
2. a review of existing market-based conservation opportunities in the rangelands, which included comparing the design requirements, and investigating the economic feasibility of new conservation incentives

3. recommendations on what is needed to create a more open marketplace for biodiversity incentives in rangeland Australia, if required following this review
4. based on a pre-test using focus groups across 4–5 regions, the degree of likely uptake of an incentive program and the degree of change (management and/or areal extent) likely to be offered in the marketplace.

The commission gave the 2004 study a national context by reviewing the incentive opportunities available to Aboriginal people in the spinifex deserts, and including two extra pre-test case studies in New South Wales and Queensland.

The research consortium for the commission included the collaborators mentioned above, as well as the Queensland Murray-Darling Committee Inc., South West NRM Ltd (Queensland), the New South Wales Department of Environment and Climate Change (formerly Department of Natural Resources), the Central Land Council (Northern Territory) and the Ngaanyatjarra Council (eastern Western Australia).

Dr Anita Smyth of the Rangelands and Savannas Program, Sustainable Ecosystems at CSIRO in Alice Springs led the project team. The work was divided into four research components, and is documented in four parts of this report. The four parts in the series *Enabling the market: incentives for biodiversity in the rangelands* are:

1. *Issues and opportunities for using market-based instruments for biodiversity conservation, with the Stony Plains bioregion as a case study* (Gorddard, Whitten, Coggan, Yunus)
2. *Incentive opportunities for Aboriginal lands of the spinifex deserts* (Davies, Maloney, Gambold, Edwards)
3. *Scoping a biodiversity metric for conservation incentives, using the Stony Plains bioregion as a case study* (Smyth, Brandle, Fleming, Goddard, Read, Whitten)
4. *Policy options for providing conservation incentives in Australian rangelands* (Goddard, Whitten, Smyth)

Key recommendations

Biodiversity tender design recommendations

- Ensure acceptable participation rates via communication and regional trials.
- Base schemes regionally to develop appropriate tender mechanism and process.
- Start small to manage risk and allow time for tenders to be tailored to regions.
- Significant funding to ensure the benefits outweigh the start-up costs and the risks of diminishing intrinsically motivated biodiversity management.
- Provide medium-term funding: Medium-term contacts (5–10 year) to ensure effective management changes in a variable environment.
- Have flexible specifications which allow for innovation and encourage tailoring to local needs.
- Consider whole of lease contracts to control for intensification and adverse effects on biodiversity on other parts of the property.
- Minimise transaction and monitoring costs for all parties as managers' time can be a limiting factor in engagement in a tender process.

Incentive opportunities in the Aboriginal lands of the spinifex desert

Recommendations for creating a more open biodiversity marketplace in this region are:

- support establishment of landowner collectives with contracting capacity – effective 'social enterprises' which employ landowners, particularly youth, in 'ranger' roles and provide valued mentoring roles for elders
- seek opportunities to implement micro-enterprise approaches in which individual landowners and family groups are paid on a contract basis for specific biodiversity services with flexibility in how they integrate provision of these with other aspects of their lifestyle
- aim to develop all elements of the market chain, recognising the key role of mid-level organisations and individuals as brokers for biodiversity and other compatible services (such as eco-tourism, sustainable grazing, carbon sequestration, and land condition and water resource monitoring) as part of a 'conservation economy'
- invest in capacity building through social sectors of government in recognition of the health and wellbeing outcomes that can be anticipated from well-designed programs that engage landowners more actively in management of their land
- invest in specifying priority biodiversity outcomes for the region, in parallel with a concerted program to build landowners' awareness about what other people value about the biodiversity on their lands and why
- direct investment to biodiversity outcomes that appeal to strong landowner motivations such as pride in productive country, knowledge and skills, as well as income generation
- invest in developing metrics for biodiversity benefits through fire management
- invest in developing measurement protocols that engage landowners' skills and know-how and provide scientifically robust measurement as a basis for contracting services in environmental survey and monitoring, ground-truthing of remotely sensed data and models, and for measuring other contract outcomes
- foster networks among landowners involved in these activities and promote an adaptive learning system that embeds quality assurance and feedback on performance.

Biodiversity Metric

- The purpose of all biodiversity metrics should be clearly defined so that the communication of their roles with end-users is improved.
- Biodiversity incentive metric design should be developed concurrently with incentive policy design and other regional conservation planning processes.
- An integrated approach involving linked conceptual and operational frameworks as proposed in this document should underpin the development of biodiversity incentive metrics in Australia's rangelands.
- Ample resources should be made available to refine the design issues beyond those already documented in regional plans and to run interdisciplinary workshops.
- The design of biodiversity incentive metrics should consider the 'Principles of Metric Design' for incentive policies.
- Achievement measures should reflect the ecological function of the attributes representing the regional biodiversity values and their selection should be directed by the guidelines for surrogate selection to increase their scientific credibility.
- A combination of field-based and remotely-derived data for achievement measures should be adopted to increase acceptance by producers of a biodiversity incentive metric.

- Incentive policies and their metrics should be designed in a way that makes them readily understood by producers and administrators. Where possible, multiple incentives and metrics should replace a one-size-fits-all approach.
- Metric structure will need to include regional level achievement measures as benchmarks to be applied in a regional context.
- There should be investment in calibration and further development of surrogate spatial datasets for bioregions as described for BioRewards Pilot.
- There should be investment in the formal acceptance and scientific credibility of the structure of BioRewards Pilot before any further refinements.

Recommendations on the suitability and selection of market-based instruments for biodiversity management in the rangelands

- A market-based approach to biodiversity policy in the rangelands would appear to be a feasible and valuable policy option.
- A well-designed MBI can overcome a number of deficiencies that exist in alternative policy approaches.
- A price-based tender approach, where the government acts as a purchaser of biodiversity outcomes, and the price is determined by selection of competing bids from potential participants, is most likely to be successful in the rangelands.

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Abbreviations/Acronyms

ABS	Australian Bureau of Statistics
AGDEH	Australian Government Department of the Environment and Heritage
ALRA	Aboriginal Land Rights Act
AnTEP	Anangu Teacher Education Program, University of South Australia
ATSIC	Aboriginal and Torres Strait Islander Commission
APY	Anangu Pitjantjatjara Yankunytjatjara
BBI	Biodiversity benefits index
BSS	Biodiversity significance score
CDEP	Community Development Employment Projects, an Australian Government Program
CLC	Central Land Council
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CUMSUM	Cumulative sum of deviations from the mean
DEH	Department of Environment and Heritage, South Australia
DKCRC	Desert Knowledge Cooperative Research Centre
DPIFM	Department of Primary Industries, Mining and Fisheries, NT
DWLBC	Department of Water, Land and Biodiversity Conservation, South Australia
ED	Environmental Distance
EOI	Expression of interest
FCA	Federal Court of Australia
GABSI	Great Artesian Basin Sustainability Initiative
GDM-SS	General dissimilarity modelling for single species
GIS	Geographical information system
GPS	Global Positioning System
IBRA	Interim Biogeographic Region of Australia
ILC	Indigenous Land Corporation
IPA	Indigenous Protected Area
IUCN	World Conservation Union
JVAP	Joint Venture Agroforestry Program
LMU	Land Management Unit (of land council or Aboriginal landowning body)
LUCIS	Land use change impact score
MBI	Market-based Instrument
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of understanding
NAPSWQ	National Action Plan for Salinity and Water Quality
NBBI	Native biodiversity benefits index
NGO	Non-government organisation
NHT	Natural Heritage Trust
NLC	Northern Land Council
NRM	Natural Resource Management
NT	Northern Territory
PP	Palatable to stock and persistent after long dry periods
RFID	Radio frequency ID

RIRDC	Rural Industries Research and Development Corporation
RPA	Regional Partnership Agreement
RS	Remotely sensed
RTO	Registered Training Organisation
SA	South Australia
SADEH	South Australia’s Department for Environment and Heritage
SADWLBC	South Australia’s Department of Water, Land and Biodiversity Conservation
SOE	State of the Environment
SRA	Shared Responsibility Agreement
SWOT	Strengths, weaknesses, opportunities, threats
TGP	Total grazing pressure
TN	*Training Nintiringtjaku*, an initiative of Waltja Tjuṯangku Palyapayi
TSN	Threatened Species Network, WWF World Wide Fund for Nature
VET	Vocational Education and Training
WA	Western Australia

Part 1: Issues and opportunities for using market-based instruments for biodiversity conservation, with the Stony Plains as a case study

Russell Gorddard

Stuart Whitten

Anthea Coggan

Famiza Yunus

May 2007

Executive summary

This paper discusses the potential for market-based instruments (MBIs) to provide incentives for biodiversity management in rangelands, focusing on the Stony Plains bioregion as a case study. It provides background for a second paper that looks at specific MBI design options that may have potential in the region.

The potential for MBIs

Three key issues define the rangeland biodiversity policy environment: (1) the public good nature of biodiversity conservation; (2) the need for clear property rights; and (3) the difficulty of defining and measuring a metric for biodiversity outcomes. Given this environment, MBIs have significant potential to provide incentives for biodiversity outcomes in the rangelands in a way that is more effective and efficient than other policy approaches. This potential emerges from the large variation in the costs and benefits of biodiversity management across the rangelands. MBIs can exploit this variation, and pastoralists' knowledge of this variation, to provide more effective and efficient biodiversity management. The potential benefits include lower cost to government, as well as greater flexibility and lower compliance costs for landholders.

Issues for MBI use

Several issues need to be addressed if this potential is to be realised. The two most important are: the need for clear property rights; and the difficulty and cost of collecting information on biodiversity management and outcomes over large areas and for complex ecosystems. Imperfect and private (asymmetric) information raises several issues for metric design. Different metrics are required for different purposes and steps in the MBI process. Metrics also need to be tailored to the specific MBI used. A combination of input, output and management controls are likely to be needed for effective policy. Understanding how to combine and coordinate these different levers is a key challenge for MBI and metric design.

Given the small numbers of pastoralists, uptake is important and this requires low engagement costs, strong in-principle support for the scheme's objectives, flexibility in the specification of requirements, and careful management and communication of risk issues.

The difficulty of monitoring means that it is important to build on intrinsic motivations for biodiversity management. The support and participation of pastoralists in an MBI scheme is therefore important.

The process of MBI design

The broad choice of MBI can be classified as either price based, quantity based or facilitative. However there is no one-size-fits-all approach to designing MBIs for conservation outcomes. MBIs need to be designed for specific situations and in close consultation with the intended users. Future work will focus on developing and field testing MBI options for biodiversity management in several rangeland regions.

1. Introduction

The aim of this paper is to examine the issues and opportunities for using market-based policy instruments (MBIs) to provide incentives for improved biodiversity conservation in the Australian rangelands using the Stony Plains bioregion in South Australia as a case study.

MBIs are policy tools that encourage certain behaviours through market signals rather than through explicit directives such as regulation. MBIs bring about change by altering the pay-offs faced by land managers for various land management actions and outcomes. MBIs applied in a natural resource management (NRM) context have received increasing attention recently; for instance, the National Action Plan for Salinity and Water Quality has established the National Market-based Instruments Pilots Program with funding of $10m over five years to investigate the potential for MBIs to improve natural resource management.

This paper aims to identify the constraints and opportunities for MBI use in the rangeland. It does this in four sections. The remainder of this section provides a brief overview of the land use characteristics of the Stony Plains region.

Section 2 describes the range of MBI options, and gives examples of their application in Australian natural resource management. It then discusses the theoretical basis for MBIs, and identifies some of the key issues that need to be addressed in selecting and designing them.

Section 3 explores how the issues and opportunities identified in section 2 apply to the case of the Stony Plains. This builds on results of a workshop held in Adelaide in 2005 that looked at:

- the key biophysical management objectives
- the main management changes that are required
- options for monitoring and measuring biodiversity outcomes.

Section 4 concludes by identifying the key issues that determine the prospects for successful development of MBIs in the Stony Plains context.

1.1 Background on the Stony Plains bioregion

The Stony Plains bioregion covers an area of 129,240 square kilometres or 13% of the area of South Australia. The *Draft Biodiversity Strategy Stony Plains Bioregion* (DEH 2005) provides a detailed description of the biodiversity values and threats in this region. Figure 1 shows the location of the region and Figure 2 indicates the land use and scale of the properties that cover the Stony Plains. A small number of large cattle leases cover the majority of the area north of the South Australian Dog fence, while a larger number of smaller sheep properties are south of the fence. In addition there are significant areas of national parks on and adjacent to the bioregion.

SOUTH AUSTRALIAN ARID LANDS NRM REGION

Interim Biogeographic Regionalisation for Australia (IBRA) Bioregions

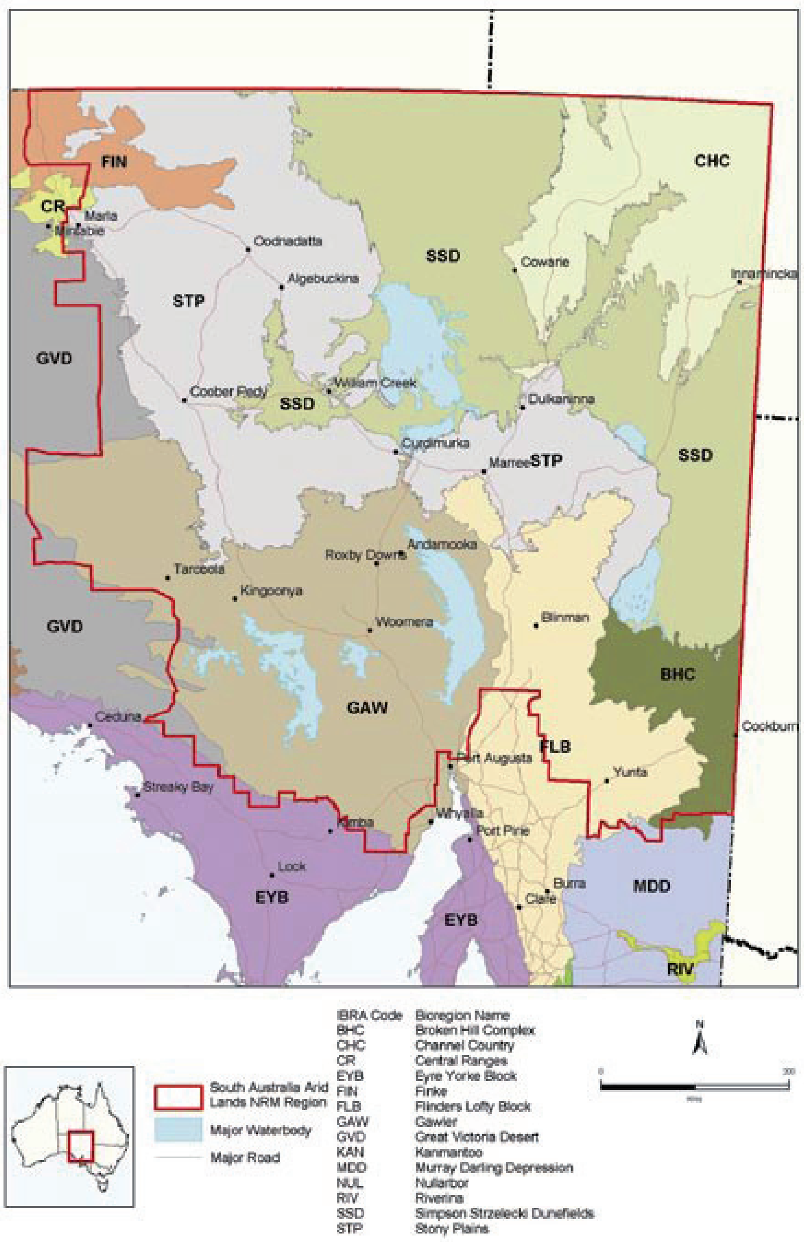

Figure 1: Bioregions of South Australia including the Stony Plains

Source: DEH 2005

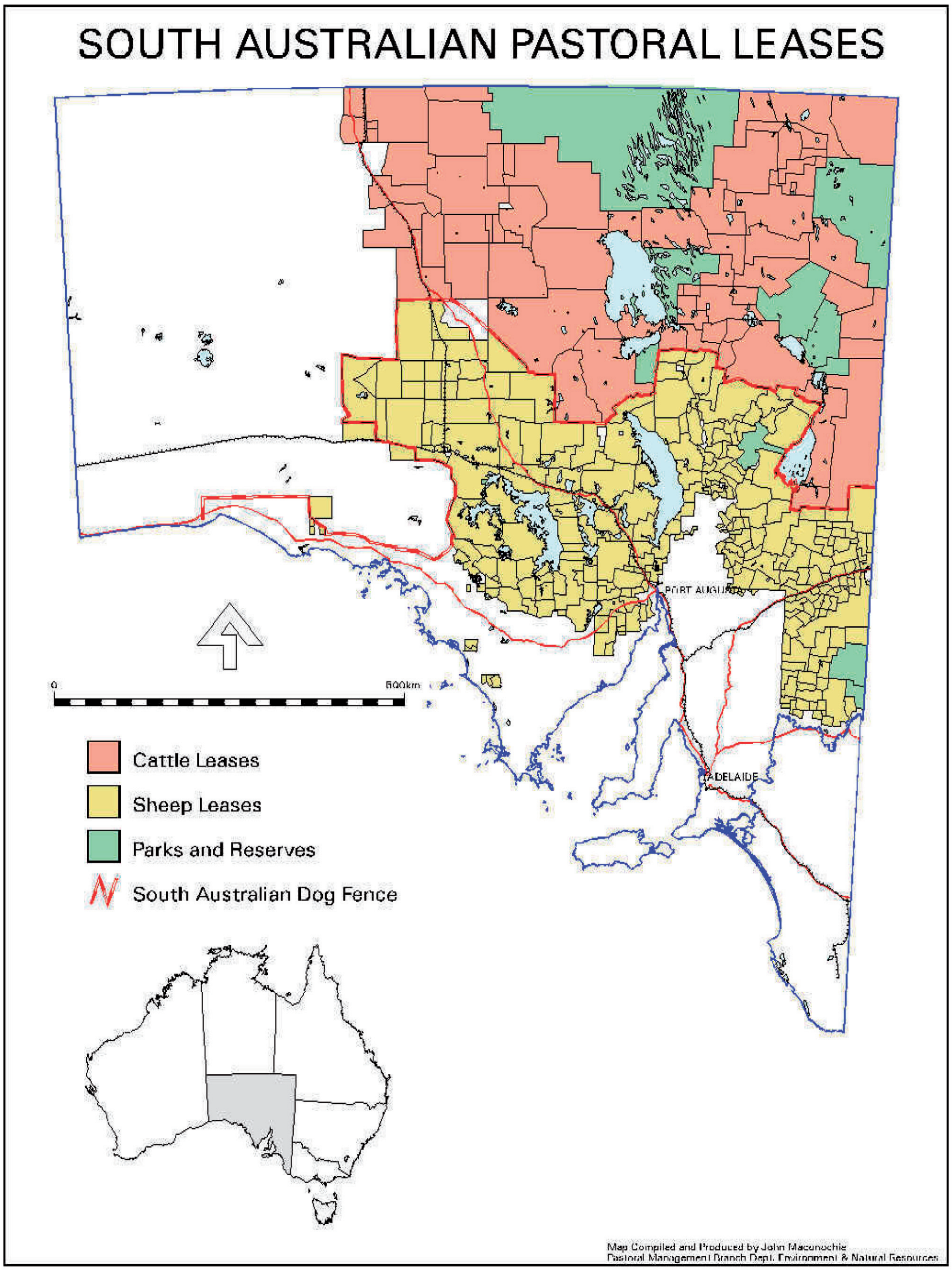

Figure 2: Map of Pastoral Leases in South Australia

Source: Sustainable Resources, DWLBC 2002

At a workshop held in October 2005 as part of this research project, participants attempted to define important biodiversity assets and biodiversity conservation objectives in the region.

The key biodiversity characteristics of the Stony Plains region were identified as:

- A mosaic of natural habitats and high value sites: these include areas that remain functioning as untouched systems and areas with keystone and unique species.

- The overall integrity of the landscape: this includes the connectedness and resilience of the land; the capability of the land for nutrient retention and cycling; and the ability to respond to boom/bust cycles.

Key components of the biodiversity conservation objectives were identified as including:

- ecosystem function and connectivity
- diversity of habitats, species and condition
- riparian vegetation and water quality, particularly due to the scarcity of water in the region
- identification and management of special sites.

These basic features of the region are likely to have important implications for policy design. Notably, there are a small number of producers, with different types and sizes of properties, and the biodiversity management problem is complex, multidimensional and involves whole-of-landscape issues. In addition to these basic features we would expect a range of social, economic and historical aspects of the region to be important in determining the appropriate policy design. However, reviewing these issues is beyond the scope of this report.

2. An overview of market-based instruments and how they work

Government interventions aimed at improving the management of natural resources can be divided into three categories:

- **Facilitative:** measures designed to improve information flow and corresponding signals and incentives without providing any direct incentive payments to landowners, e.g. extension programs providing information about how to manage land to improve biodiversity conservation.
- **Incentive:** measures designed to directly alter the structure of pay-offs to land managers; these programs are usually specifically intended to substitute for the missing monetary signals that are generated in markets for other goods and services.
- **Regulatory:** non-voluntary measures designed to compel management change using the coercive powers of government, e.g. regulations designed to protect native vegetation.

Market-based instruments (MBIs) generally fall into the ‘incentive’ category of intervention. They are one way for government to bring about an increased level of supply of environmental and cultural goods. MBIs are policy tools that encourage certain behaviours through market signals rather than through explicit directives such as regulation, although they are often underpinned by regulation. MBIs bring about change by altering the pay-offs faced by land managers for various land management actions.

MBIs applied in an NRM context have received increasing attention recently. This is because, when designed correctly, they can deliver outcomes at lower cost to government, and with improved flexibility and lower compliance costs to landholders, than many alternative instruments. MBIs achieve these benefits in three ways:

1. by allowing flexibility in the way participants choose to respond to the instrument
2. by encouraging, through this flexibility, change by those who can achieve change most cheaply, as opposed to broadly levelling change requirements on all
3. by encouraging adaptive management and ongoing innovation.

Well-designed MBIs will attempt to harness all three of these benefits. However, it is important to note that pragmatic design considerations may limit or remove the gains of MBIs over other instruments.

MBIs in Australia are commonly characterised as price-based, quantity-based or 'market-friction' instruments. Figure 3 (adapted from NMBIPP 2004) describes some characteristics and examples of each type of MBI. Both price- and quantity-based markets correct market failures by modifying or generating price signals to encourage behaviour changes, or by enabling flexible compliance in meeting target environmental 'quantities'. Market-friction mechanisms primarily target existing markets by improving the function of the market, or creating new markets to interact with existing markets.

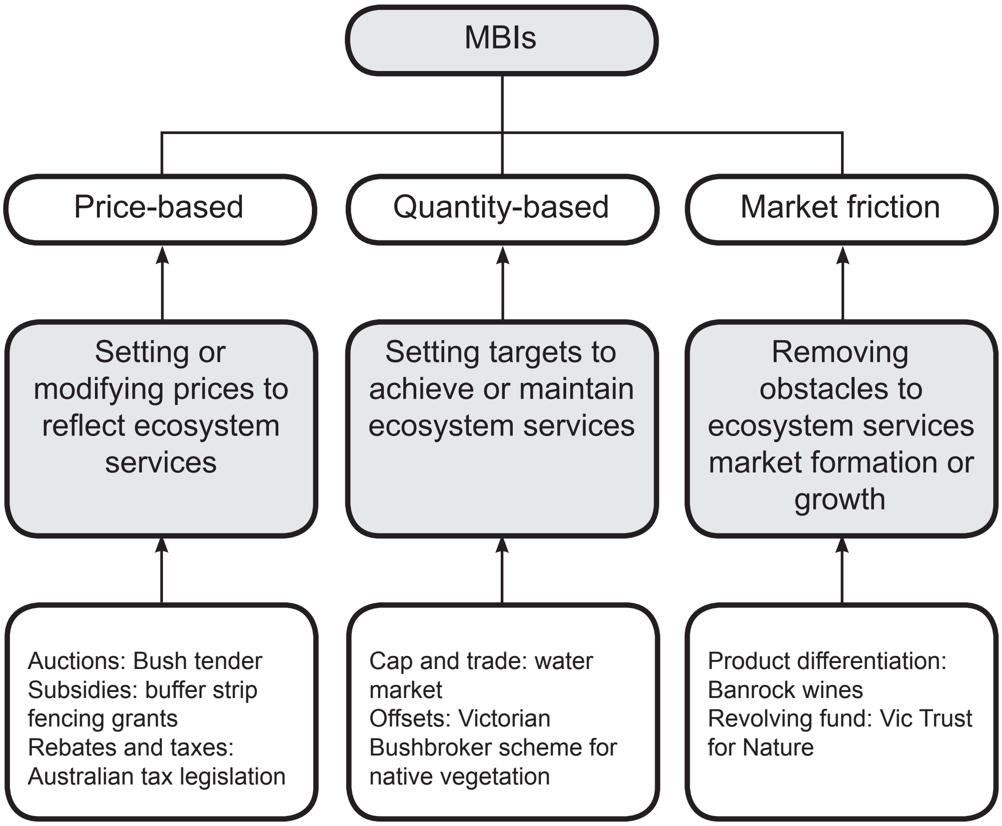

Figure 3: Types of market-based instruments

2.1 The process of MBI development

While designing incentive measures is straightforward in a theoretical sense, how to practically select, design and implement biodiversity conservation incentives interventions is not so clear. Coggan et al (2005) distil biodiversity conservation policy interventions into five key steps that can be used to guide policy makers in achieving these principles. The steps are:

1. **Policy identification and prioritisation:** Understanding the problem – identify the constraints and opportunities for policy and select best bet option for development. This involves a desktop study of the fundamental reasons for market failure, and stakeholder workshops to scope the range of issues influencing the policy environment.

2. **Policy mechanism design:** Designing the specifics of a policy and specifying the strategy for dealing with the constraints identified in Step 1. Issues may include the metric design, risk sharing, communication plan, contract design, and monitoring methods, plus specific rules for engaging in the 'market'.
3. **Policy mechanism testing and preparation:** This may involve laboratory testing of aspects of the market mechanism; field workshops; and field testing specific elements of the mechanisms (e.g. the practicality of the metric). This step can often be integrated with the process of engaging potential participants and training them in how the scheme works.
4. **Policy roll-out:** Specifics depend on the MBI type. Auctions, for example, typically start with a call for expressions of interest.
5. **Monitoring, evaluation and feedback:** Identifying issues with the entire system, from implementation through to market behaviour (e.g. participation issues), contracted actions and desired outcomes.

This paper is designed to address Step 1, that is, to understand fundamental market failure and identify the constraints and opportunities for MBI use to protect and conserve biodiversity in the rangelands.

2.2 How markets work

Designing MBIs requires applying the principles and theory of how markets and policies work to the particular problem. This section describes the relevant theory of how markets work, why they fail and how they emerge and change. From this discussion a number of MBI design issues are identified, which are used to structure the discussion in the next section.

A market is simply defined as the bringing together of a buyer and a seller so they can engage in voluntary exchanges. The simplest of markets involves a bartering system, while more sophisticated markets have prices and monetary exchanges. The process of negotiating a complex one-off exchange, or completing a sale between a buyer and seller for a consumer good, reveals a price for the item exchanged. Markets emerge and evolve as people with different values for an item seek to benefit by trading. Markets can therefore vary greatly in their form, and in the extent to which they manage to create value. Several important characteristics of markets provide the basic framework for thinking about market-based instruments.

The fundamental driving force for markets is the variation, or heterogeneity, in people's value for an item. This heterogeneity in value determines the potential gains from trade that markets can generate. The potential gains from trade and mutual benefit give people the incentive to overcome the costs and uncertainties of trading with others.

Prices are a key feature of effective markets. As discussed, a price is revealed when a trade occurs. Prices do three things:

1. provide an incentive to use the cheapest method of production and to use resources for their most highly valued use
2. transmit information about values
3. determine who gets what – the distribution of gains from trade.

The three functions are, for the most part, inseparable. Specifically, prices and markets cannot perform the first two functions without at least partially affecting the distribution of income. There are limits to what markets can achieve if we wish to limit the implications for income distribution. Issues of fairness, social acceptability of potential redistributions, and the potential effect of wealth redistribution on natural resource management therefore need to be considered.

It is useful to think of what is being traded in markets as a set of socially defined property rights – or the extent to which society endorses someone's claim to a stream of benefits. The rights are encoded in rules or institutions that govern how the market works. This view highlights the importance of the institutions of the market, and the broader institutions of society, in defining the trade.

Specifying and allocating property rights can be difficult for two reasons. Firstly, this process allocates wealth, and so inherently generates conflict. Secondly, there are many attributes and possible contingencies related to a traded item. It can be difficult to foresee and allocate rights in a way that encourages trading. Applying principles for rights that have been developed and tested for similar items (e.g. adapting the Torrens land title system to water) can therefore be a useful strategy.

2.3 Market failures and imperfections

An ideal marketplace will generate prices that give land managers incentives that reflect society's values. If the private benefits and costs that a resource manager faces do not equal the broader societal benefits and costs, a market failure is said to occur, and we do not expect the resource manager to make decisions in society's best interests. Market failures can limit or prevent trade – and the consequent gains from trade – being realised. Important market failures relate to:

- attributes of the good or service to be traded
- information about the attributes of the good
- attributes of the marketplace.

2.3.1 Failures associated with attributes of the good or service

With public goods, many individuals can derive benefits from a single unit without affecting the value to others. If the owner of a public good cannot exclude people from these benefits (in order to charge people for the benefits of the public good), the goods are likely to be under-provided. The non-rival aspect of public goods tends to be an innate property of the good, however the extent to which the benefits can be excluded tends to depend on technology. For instance, the intellectual property in music is a pure non-rival good. The extent to which these benefits can be captured by the owner has been changed by the ability to send copies over the internet. Non-excludability is one way in which property rights can be poorly defined.

Fungibility refers to the extent to which goods are interchangeable. If the attributes of goods are not the same then it can be difficult for people to compare values. Markets can cope with this variation; for instance, in housing markets buyers are forced to compare houses with a range of different attributes. In this instance, the prices of houses with similar bundles allow market participants to infer the value of a given house. For fruit markets, quality can vary, so purchase usually requires a careful inspection. While markets can still function, the role prices play in conveying information about society's value for a given resource is diminished.

2.3.2 Limited information about the attributes of the good

Incomplete knowledge about the attributes of the good traded can cause problems for markets.

If information about the important attributes of an item can be discovered, investing in research can reduce scientific uncertainty and improve the market. This information, however, has public good characteristics and will generally be under-provided, as once it is discovered, it is difficult to prevent others from benefiting from the knowledge without paying for it.

If nobody has complete information about some attributes of an item, and the attribute cannot be controlled or known before sale, then the problem is one of risk and risk allocation between the buyer and the seller. Risk allocation affects prices, as a risk premium must be paid for a person to be willing to bear the risk.

Asymmetric information problems arise when one party has useful information about the attributes of the good that is not available to the other party, and can use it to their advantage when trading. This type of asymmetric information typically causes markets to be inefficient, in the sense that all individuals could be better off if the asymmetric information issues did not exist.

An issue related to asymmetric information problems is that of incomplete contracting. If goods or services are bought ahead of time, it can be difficult to foresee all of the issues that may exist with the delivered good. This means that the provider has discretion about some aspects of the good or service that is delivered and they may choose to deliver on the letter rather than the spirit of the contract.

2.3.3 Attributes of the market place

Generally, a large number of market participants is required to create competition among buyers and among sellers that encourages individuals to bid according to their values rather than to manipulate prices. The number of market participants can therefore induce a market failure. However, Vickrey (1961) found that under certain circumstances, the correct market design can encourage participants to reveal their true values and result in an efficient outcome even with very low numbers of participants.

2.4 Other issues in MBI design

In many instances mixing policy instruments in various ways may be necessary for effective control. If contracting for outcomes is difficult then policy focus may broaden, influencing outcomes indirectly by changing incentives for input use and management practices. In other instances there may be multiple market failures that need addressing.

Societies adapt to market failures in a range of ways to minimise their impact. Existing institutions need to be understood as the introduction of MBIs can have negative impacts on them. This is termed institutional crowding out (see, for example, Reeson and Tisdell, 2006).

Perfect markets rarely exist. Most markets have multiple failures and the issues tend to interact. The appropriate MBI design will therefore depend on the characteristics of the given problem and will involve various compromises. A range of additional issues emerge in design of specific markets. However these need to be discussed in the context of a specific MBI proposal.

3. Policy design issues for the Stony Plains

This section identifies and discusses some of the key issues in developing an MBI for biodiversity conservation and management. It is based on the above discussion of MBIs and builds on the results of a workshop held in Adelaide in October 2005 that looked at the key biophysical management objectives, the main management changes that are required, and options for monitoring and measuring biodiversity outcomes.

The key issues for assessing the potential for MBIs for biodiversity conservation on the Stony Plains are discussed under the following headings:

- biophysical objectives
- measuring and monitoring
- metric design issues
- management options
- public good attributes
- property rights
- heterogeneity in value
- fit with and adapting existing institutions
- income distribution
- risk and risk sharing
- number of market participants and market power
- mixing policy instruments

The next three sub-sections require some introduction. Section 3.1 discusses the biodiversity objectives. Ideally we would like a measure or metric of how well our biodiversity goals are being achieved and the impact of management actions. We find that it is difficult to define a good measure of this objective. Section 3.2 looks at the information (data) that is required to develop a metric, and at the conflicts of interest that may arise for landholders who collect the information that forms the basis for the biodiversity incentive. Section 3.3 looks at the metric design problem. The appropriate metric will depend on its specific purpose, and we may want to use different metrics for different roles. Two different uses for metrics are identified.

3.1 Biodiversity objectives

The biodiversity objectives are the goods or outcomes that we seek to purchase in our new market. Hence it is important to clearly specify what we seek to achieve and to trade. The results from a workshop exercise to try to define this objective for the Stony Plains is discussed in Section 1.1. While these objectives are reasonably clear, they are not a well-defined measure of biodiversity outcomes. This causes a range of complexities for conservation incentives. The difficulty with defining a measure arises from:

- **Spatial interdependence of conservation values:** The value of placing one unit of land under conservation management depends on the status of others in complex ways.
- **Diverse values and valuers:** The reasons behind different biodiversity values are multiple, and change as we become better informed (e.g. understanding the role of ecosystem services).

- **Scientific uncertainty:** The ecosystems are complex and only partially understood. For instance, the extent to which a certain ecosystem is at risk is generally unknown.
- **Costly monitoring:** Given that the system is spatially dispersed, inherently variable, complex, and has multiple valued attributes, monitoring will be expensive and incomplete.

There is an obvious need to be pragmatic in designing biodiversity metrics. The specific function of a measure should guide the choice of measure. Given that there are several different functions, we may need to use different measures for different purposes.

3.2 Measuring and monitoring

Information on the system is required for at least three reasons:

1. to understand how it works, in order to identify the appropriate management regime (research)
2. to understand the state of it, in order to have the knowledge to select the best management option (management and monitoring)
3. as a basis for specifying outcomes that will be used to provide biodiversity management incentives to pastoralists (contracting).

Some output-based methods for information collection include:

- *Land Function Analysis score* – a widely accepted, well-developed, and repeatable method for the measurement of perennial vegetation cover. However, it is resource intensive.
- *Grazing gradient* – covers large areas through the use of satellite imagery. However, this procedure may not be useful for all land types and can only be carried out in suitable seasons. It is not as effective as on-ground measures.
- *Key/Indicator Species Index* – based on the presence of species at a certain level in the landscape as an indicator of a healthy functioning system. This process needs to be developed for a diversity of land types and is resource intensive.

A major component of the research in this project is to further explore opportunities and frameworks for measurement, and is being undertaken by Anita Smyth and colleagues.

3.2.1 Conflicts between information uses

Data collection to better understand the system often requires cooperation between researchers and land managers (participative research). However, data used to enforce contracts is often the same information required for these other purposes. Tensions can therefore exist between the uses of this information. Landowners may be unwilling to share information and cooperate in data gathering if the research will result in more costly management, or if it will result in management contracts that are more disadvantageous to them than current understanding.

Two principles arise from these issues:

1. When designing monitoring and data collection systems, the full range of costs and benefits (from research, management and contacting) and the distribution of benefits (how it affects landowners) from increased data collection need to be considered. The data collection needs to be in the land manager's best private interest.
2. When we are considering using information as the basis of a contract, the potential for this use to distort the information collection and sharing process, and subsequently reduce the research and management benefits (above), need to be considered.

Sequencing monitoring and research activities can overcome these conflicts to some extent. For instance, research to help understand the system logically precedes monitoring for management purposes, and regulation.

3.2.2 Asymmetric information

Typically, knowledge of the state of the system is most efficiently collected by the land manager. As the land manager has discretion about how much of this information is shared with others, asymmetric information problems can arise.

Note that in most markets, asymmetric information about production processes is not a problem. In fact, one of the advantages of a market is that it allows decentralised decision making that uses the private knowledge of a range of people. However, asymmetric information problems about the attributes of the traded item can cause a market to stop working effectively. In the case of rangelands, where a perfect measure of conservation is not possible, we may wish to contract to control inputs and management practices. In this case, asymmetric information about these items, as well as about outputs, becomes a concern. Asymmetric information may exist about:

1. the cost of management actions in time and space
2. the attributes of conservation value that exist on a land unit
3. the impacts of management on biodiversity conservation.

In addition, government agencies may have extra information about 2 and 3. A well-designed MBI will structure incentives so that land managers use their private information efficiently. This requires providing positive incentives to reveal and use the information in a socially optimal way. This does not imply that negative incentives (taxes or regulation) are necessarily worse than positive incentives (subsidies or market payments) under asymmetric information. The issue is not whether the incentive is positive or negative, but the expected private cost to the farmer of the policy being implemented with and without them using their private information.

There is generally a rent extraction/efficiency trade off in asymmetric information problems. That is, the resource owner or buyer must give up some of the potential profits to ensure the manager has the correct incentives to manage the resource efficiently. This may limit the extent to which government can, and should, use its buyer power.

One solution to the asymmetric information problem is to monitor things that can be easily observed and verified to remove room for strategic behaviour. This is part of the justification for considering input and management controls as well as output-based contracts.

In summary, the value and cost of information needs to be considered as an integrated part of the policy problem. In particular, in the same way that we may pay for conservation outcomes, consideration should be given to paying for improvements in the state of information about the system, independent of the conservation outcome achieved. The potential benefits of dynamic efficiency in monitoring should be considered in policy design. That is, if possible, there should be incentives to create new ways to monitor conservation performance, and to focus research effort in areas where it is likely to have the biggest return to biodiversity conservation.

3.3 Defining a biodiversity metric

A biodiversity metric is a summary statistic of the information available on the state of the area. Given the difficulty in defining a biodiversity outcome, metrics may have two distinct uses:

- to assess the state of the system: is the desired outcome achieved?
- as a basis for specifying the contract action: did the landowner do what was required to meet the terms of the contract?

The two purposes may require different metrics. Here we are concerned with the second purpose. We would still like the metric to reflect as closely as possible the desired biodiversity outcomes; however, other factors will come into play as well.

The metric needs to reflect the gain in conservation outcome, as measured from a baseline. For this reason the baseline level of conservation needs to be well-defined (the property rights issue – see section 3.6). We are also concerned with how inaccuracies in the way the metric reflects conservation values may provide perverse management incentives to landowners.

We also need to identify the important margins where trade-offs will be actively considered. The metric will need to reflect the appropriate ‘prices’ for these trade-offs. These may include:

- trade-offs between conservation in different land types
- trade-offs between small areas of high conservation value versus large areas of lower conservation value
- the value of different spatial configurations and impacts on landscape connectivity.

3.3.1 Fungibility

One purpose of a biodiversity market is to send a signal to landowners about the value of biodiversity conservation activities and outcomes so that they can incorporate this information into their planning and day-to-day decision making. The design of the metric will be important in determining to what extent the generated price signals will be applicable to other areas and other situations.

3.3.2 Incomplete contracting

Contracts which are incomplete, or are of uncertain quality, are not necessarily a barrier to MBIs. However, institutions need to develop to deal with this issue. Reputation may be important where repeat business is done. Conservation covenants overcome this problem by removing the possibility of profit from other land uses, and then providing positive incentives for better management.

There is potential to specify contracts for long-term conservation outcomes, even if the details cannot be specified, provided a good relationship between the landowner and the contracting agent can be established. Setting a reasonable opt-out price from the management contract can also be important in encouraging uptake (see Risk).

3.4 Management options, issues and risks

Excessive total grazing pressure is a major threat to biodiversity in the region and the main focus of this paper. The grazing pressure comes from the combination of domestic stock, as well as native and feral grazing animals. Three key elements to grazing pressure are:

- water availability
- feral animals
- stocking rate and timing.

The spatial extent and timing of these management issues are fundamental to the management strategy. Planning and management needs to be carried out at a regional scale across land types to maintain diversity, connectedness and function. Core areas and special places need to be managed so that the ecosystem is able to respond to boom cycles. The timing and spatial pattern of grazing pressure affect both the ecology and profitability of grazing systems.

Coordinated management is required, as managing any one of these issues in isolation is unlikely to be effective. There are significant risks of unintended consequences and knock-on effects of changed management regimes. For instance, restricting and redistributing watering points could change other land management practices, such as increasing the stocking rates in other areas, and could have uncertain impact on the number and effects of non-domestic grazers. Changes to all management levers, plus monitoring, is likely to be required to generate effective biodiversity outcomes.

Property boundary and size adjustment may be an important component of effective management. This may be necessary to internalise management of specific land units to a single owner or to recreate economically viable grazing management units once areas have been set aside for conservation. Policies that make property transfer and boundary realignments expensive may need to be examined.

3.5 Rangeland biodiversity public good attributes

Biodiversity conservation is a public good. A large component of the value people hold for biodiversity conservation is an existence value. Given the non-rival and non-excludable nature of these values for biodiversity conservation, they will not be expressed fully in a market. Governments therefore have a role in efficiently expressing society's value for conservation. This places government as almost the sole purchaser, or monopsonist.

Note that as government may not efficiently represent this interest there is also a role for private philanthropic organisations to invest in biodiversity conservation. The impacts of MBIs on this private investment need to be considered. Establishing clear baseline property rights is perhaps the main requirement for private philanthropy to be able to invest effectively without the risks of either substituting for government payments or paying for changes that will later be required.

3.6 Property rights

Property rights effectively define who has what rights and responsibilities. Until a clear baseline of rights and responsibilities is defined it is difficult to establish an incentive mechanism that rewards outcomes relative to the baseline. The lack of a defined baseline for landowners' responsibilities for biodiversity creates uncertainty for investors in biodiversity in the region. This uncertainty is enough to prevent most MBIs from operating. Table 1 lists some of the attributes of property rights that enable trade.

Table 1: Desirable attributes of property rights

Property right characteristic	Description
1. Clearly defined	Nature and extent of the property right is unambiguous.
2. Verifiable	Use of the property right can be measured at reasonable cost.
3. Enforceable	Ownership of the property right can be enforced at reasonable cost.
4. Valuable	There are parties who are willing to purchase the property right.
5. Transferable	Ownership of the property right can be transferred to another party at reasonable cost.
6. Low scientific uncertainty	Use of the property right has a clear relationship with desired outcome.
7. Low sovereign risk	Future government decisions are unlikely to significantly reduce the property right's value.

Source: Murtough et al 2002

Defining a property rights allocation that shares the resource and is therefore likely to be considered fair and acceptable to all parties can be difficult. A shared allocation requires working through the range of issues outlined in Table 1. A 'winner takes all' allocation does not have this difficulty, but is generally not an acceptable outcome to both parties. This conundrum is a key reason why natural resource property rights tend to remain uncertain and contested.

The lack of clear property rights means that a party may spend resources on negotiating and strategic behaviour in order to define the baseline in their favour. This behaviour can have negative impacts on the environment, for example, clearing of native vegetation before clearing controls are introduced.

Some flexibility exists in defining property rights. A property rights baseline can change over time, and involve partial rights and some future uncertainty. A principle for allocation of rights can be defined to guide expectations about how new issues will be treated. Specifics can then be defined over time or on a case-by-case basis. An example of a principle that has been proposed for specifying property rights is a duty of care requiring sustainable management (Hatfield-Dodds 2006).

3.7 Heterogeneity in value

The potential benefit of a market depends on heterogeneity in the values individuals have for the item. Markets create value by reallocating items from uses with low value (sellers) to uses and owners with high values (buyers) for them. If we think of a hectare of land as the basic unit, then the variation in value will be driven by variation in the public's value of different biodiversity outcomes across areas, and by variation in the opportunity costs of providing the biodiversity conservation (that is, variation in the value of production forgone to achieve the desired biodiversity outcome).

In low rainfall marginal environments the per area, or unit average, opportunity cost of removing stock and providing conservation is low. However in some instances, when feed is scarce, or for land that provides access to a watering point, the value of land for production (the opportunity cost to conservation) may be high.

Variation among farmers can also give rise to different values for conservation. This can be driven by different management regimes or personal conservation values. This variation can be large in some agricultural areas (mixed cropping system for example). The extent of variation in management systems and conservation attitudes among pastoralists needs to be explored.

The value of conservation is also likely to be variable in time and space. Note, however, that given there is a single purchaser, this variation does not provide a justification for a market over other policy instruments. (The government can learn about these values through research and can then express them directly through site-specific standards.)

3.8 Fitting with and adapting existing institutions

The absence of a fully functioning market for biodiversity conservation does not imply that society has not developed ways of at least partially providing this service. Developing new formal institutions such as markets can potentially do more harm than good if they undermine these informal institutions. This is termed institutional crowding out. Research is required to understand the informal institutions that exist in the region that maintain biodiversity. For instance, we need to ask why high value sites have retained their conservation value over time. This issue needs to be addressed both in defining property rights and in defining the metrics for policy.

3.9 Income distribution

Market trading and defining property rights affects the distribution of wealth. The perceived fairness of these processes can affect the willingness of people to be involved in them (Syme et al 1999).

In a low income environment the effect of payments for conservation could alter land management practices or maintain ineffective management practices and property boundaries.

A stream of regular, government-backed payments could also provide the basis for increased investment in the property by decreasing the overall risk. The potential for this investment to have negative conservation outcomes needs to be considered (e.g. by investing in more watering points). The fundamental solution would be to remove the perverse investment incentives as part of a coordinated policy program rather than removing the payments.

3.10 Risk and risk sharing

Policies that contract on variable outcomes, such as biodiversity, must allocate the costs and benefits that go with this uncertainty. Risk sharing involves a trade-off between allocating the risk to those best able to deal with the uncertain outcomes (for instance, an insurance company) versus allocating the costs and benefits of the risk to those with the best knowledge and in the best position to reduce the impacts of the risk (for instance, the land manager).

Scientific uncertainty, climate variability, and unpredictability of natural systems, mean there is significant risk of failing to deliver on a conservation outcome despite a manager's best intentions and management. Contracts need to maintain the incentive for good and innovative conservation management, while reducing the risk to the pastoralist. Options for doing so include:

- specifying limits to liability under the contract
- specifying contracts that are contingent on the state of nature; this requires carefully specifying the set of extenuating circumstances that permit payment despite bad outcomes

- if possible, untangling the impacts of management and climate variability by maintaining control sites as reference points for condition, and basing the contract on the difference between the two
- varying the level of external monitoring as the rainfall and biodiversity condition change, i.e., increasing monitoring when the risks to conservation outcomes are high
- requiring self-reporting and signalling of potential risk and threats to conservation, enabling the above conditions to kick in, to prevent reduced payments for less conservation.

Efficient risk management also means that ensuring that the incentives around different outcomes reflect the true cost. That is, the cost of failure to deliver the required level of biodiversity should reflect the cost of obtaining it by other means, rather than being set as an arbitrarily high punitive fine.

Australian farmers and pastoralists are used to managing risks in uncertain environments. It may be efficient to allocate a substantial proportion of the risk from biodiversity loss to land managers. The risks from biodiversity must be seen in the context of the risk profile of the farm. There are four key risks facing pastoralists in the region driven by the highly stochastic climate:

1. financial risk: farmers often rely on drawing down natural capital in lean times as a form of managing income variability
2. risk to long-term agricultural production capacity
3. risk to biodiversity conservation: variable and uncertain impacts of management on conservation outcomes associated with rainfall variability
4. risk to stock numbers: the limited ability to match stock numbers to a fluctuating grazing capacity. The risk relates to the costs of misjudging the appropriate stocking rate.

The four risks are closely related and need to be managed by pastoralists in an integrated manner. For example, limiting grazing pressure in one area to reduce the risk to biodiversity may require placing extra grazing pressure on other areas, risking the long term productive capacity of this area. Alternatively it may require reducing stock numbers, risking being under-stocked if conditions improve. The true cost to pastoralists of bearing the risk associated with variation in biodiversity outcomes may therefore be significantly greater or less than the costs appears to be if viewed in isolation.

In summary, making pastoralists bear the risks associated with biodiversity outcomes may have several implications. First, it may have implications for other outcomes, such as long-term productivity. Second, the costs to pastoralists of bearing this risk may be increased or decreased by the other related risks that they manage. Finally, pastoralists will need to be paid a risk premium in order to take on risks associated with managing for biodiversity outcomes.

3.11 Number of market participants and market power

The position of the government as a (almost) single buyer somewhat counters the inefficiency issues associated with market power. However, a reasonable number of potential sellers is required if the market is to generate competition and therefore generate price signals that reflect opportunity costs.

The size of properties in relation to the extent of the different land systems requiring protection will determine the potential number of bidders seeking to provide a given niche. This issue will influence the metric design problem and it will determine the extent of different land types and biodiversity outcomes that need to be traded off in order to generate markets of a useful size. Typically, generating enough competition will require specifying a biodiversity metric that allows trade-offs across a large range of land systems. It will also require good participation rates.

Low participation rates in an MBI can be an issue even in more densely populated agricultural regions. Participation rates will depend on awareness and knowledge of the MBI and the expected value of participating. The perceived value will in turn depend on the likelihood of success in being rewarded and the size of the reward.

Broad industry awareness of, and support for a scheme, and a large enough scheme, are therefore important. In addition, other innovative and possibly coercive measures may be required to ensure acceptable participation rates. An example of a coercive measure might be the imposition of biodiversity management standards for those who do not participate in the scheme.

3.12 Mixing policy instruments

Given the imperfections associated with output-based markets for biodiversity, a single output-based policy is unlikely to be the best option. We argue that a mix of policies is likely to be required for several reasons.

Firstly, we may wish to ensure that management and input use is structured to avoid known high risk grazing strategies or areas critical for biodiversity conservation, for example. That is, we may wish to place bounds on the management activities. Secondly, from production theory we know that substitution of one input for another is likely if we restrict some inputs. If the output-based incentive is imperfect we will wish to use input controls to prevent any perverse incentives creating too much damage. From a resilience perspective the aim is to keep management actions and outcomes within the acceptable basin of attraction. Bounding the range of permissible inputs may help achieve this.

However, care is required to ensure that input controls do not have unintended and adverse consequences. Multiple controls can be both a cure and cause of this problem. If we are confident that the bounds in place are robust, that is, applicable to a wide range of circumstances, then the principle task is to ensure that there are no other policies providing perverse incentives.

In addition to having policies that provide incentives for both outcomes and management inputs, there are several other dimensions to policy mixing:

- **Policy matching:** some policies require others to be in place before they will be effective. For example, any public investment in an area should be conditional on having property rights allocation decided.
- **A menu of policies:** we may wish to provide managers with a choice of policies to sign up to. This may reveal the type of producer (low cost of biodiversity conservation vs. high cost).
- **Tiered pricing:** A menu of prices may apply depending on the level of output. For instance, for stocking rates:
  - being above the specified maximum capacity → impose a fine
  - being below a best practice standard → incremental incentive payments
  - stock excluded → additional reward payments.

This tiered pricing structure attempts to reflect the public value of the changing marginal public value of stocking rates at different levels.

- **Contingent policies:** policies that kick in depending on the state of the system. For example, a pre-negotiated drought management plan could be used to protect areas that are sensitive to grazing pressure under drought.
- **Sequencing:** switching policies over time may also be useful. For instance, paying bounties for feral control for limited periods only may discourage maintaining a stock of the pest in order to collect future bounties. One policy may also help provide a foundation for another. For instance, under the Natural Heritage Trust (NHT), flat rate payment systems for conservation activities have allowed the payment vehicles and accountability mechanisms to be developed and community issues about the allocation of funds to be addressed. This has provided a basis for more efficient MBIs that involve variable payments. Another aspect to sequencing of policies is designing them to let old policies to be replaced by better ones as understanding increases and conditions change; this is known as a participation constraint, which requires new policies to be more attractive than old policies. Also, to avoid ratcheting up of public costs, this requires phasing out of the old policies.

4. Summary of issues for designing MBIs for the Stony Plains

The goal of MBIs is to provide land managers with better incentives so they can manage their property in a way that efficiently provides biodiversity values and production values. Given the public good nature of biodiversity conservation and the role of government and private philanthropic organisations in funding it, at another level the goal is also to encourage external investment in the region's biodiversity by providing clear, low-cost investment pathways with demonstrable outcomes. In addition, given the need for more knowledge about the system in order to improve our management, we require a policy environment that aligns landholder and public manager incentives to adaptively learn about, monitor and improve the ecosystem management.

There exists significant variability in the costs and values of biodiversity and production management across the rangelands and over time. The potential benefits of an MBI are that they can exploit this variation, and pastoralists' knowledge of this variation, to provide more effective and efficient biodiversity management.

Three key issues define the policy environment: (1) the public good nature of biodiversity conservation; (2) the need for clear property rights; and (3) the difficulty of defining and measuring a metric for biodiversity outcomes.

Several themes for MBI design emerge from the discussion. These include the need to combine input, output and management controls. An integrated incentive package needs to consider, among other things: watering points, feral animal control, stocking pressure and output incentives. Understanding how to combine and coordinate these different levers is necessary. Understanding the implications of risk and uncertainty for the correct MBI design also appears important. Given the small number of pastoralists, uptake is important and this requires low engagement costs, strong in-principle support for the scheme's objectives, flexibility in the specification of requirements, and careful management and communication of risk issues. The difficulty of monitoring means that it is important to build on intrinsic motivations for biodiversity management. The support and participation of pastoralists in an MBI scheme is therefore important.

New policy instruments also need to be integrated into the existing structures and institutions. While some MBIs can be implemented rapidly we should not expect an overnight solution to the problem of providing incentives for conservation.

This report has identified and discussed some of the key dimensions to designing MBIs for rangelands, focusing on the Stony Plains. The complexity of the issues covered highlights the need to design MBIs for a specific situation rather than simply select from a menu of options. Future work will focus on developing and field testing MBI options for biodiversity management in several rangeland regions.

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Part 2: Incentive opportunities for Aboriginal lands of the spinifex deserts

Jocelyn Davies

Jo Maloney

Nic Gambold

Rodney Edwards

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Executive summary

This study considers market-based approaches for biodiversity conservation on Aboriginal lands, focusing on the 'spinifex deserts'. The social, cultural, spatial and economic characteristics of the region mean that landowners do not detect subtle market signals. Contracting capacity is also limited. Market approaches to biodiversity conservation have potential to foster development of a conservation economy in this region, with positive outcomes for health and wellbeing as well as for ecology, provided a long-term approach is taken. This needs to: address integrated outcomes; build contracting capacity and a biodiversity 'market chain'; and engage the motivations and distinctive skills and knowledge of landowners.

The region comprises sub-IBRAs (Interim Biogeographic Region of Australia) characterised by a very hot, dry climate, hummock grasslands (spinifex, *Triodia* spp), and acacia and eucalypt woodlands. Aboriginal people own 64% of the land under statutory title, long-term leasehold and/or as instances of native title which encompass strong rights to exclude others. This amounts to more than 60% of the area of land in Australia where Aboriginal ownership is recognised as conferring strong exclusion rights.

Aboriginal people, numbering 14,500, form the vast majority of this region's sparse population. Incomes are very low, and health very poor compared with national benchmarks. Arts and craft production is the main market activity. The most extensive land use is customary production of food, although production is low compared with tropical regions. Cattle grazing is a minor land use on the margins of the region. Fifteen per cent of the region is managed as part of the National Reserve (protected areas) System, including as Indigenous Protected Areas (IPAs).

Method

The study involved consulting people with extensive experience as land management facilitators to explore motivations of the region's landowners and to scope potential incentives and metrics. We did not directly test uptake of an incentive program by landowners for reasons of ethics and cost-effectiveness given the relatively early stage of the design task and the complexity of cross-cultural communication.

Biodiversity values and threats

There has been relatively little public investment in identifying biodiversity values, priorities and targets in the spinifex deserts compared with in some other regions, or in monitoring condition of land and biodiversity resources. Cattle grazing, feral animals and lack of recorded information are issues where there is most contrast between threats to 'country' perceived by Aboriginal landowners, and threats to biodiversity identified in formal planning.

Landowner motivation and action

Some landowners are strongly motivated to engage in land use and management activities. Identity and pride linked to customary authority and responsibilities, including teaching and use of traditional knowledge, are strong motivators. However, poor health, social stress, poverty, and associated low motivation confine most landowners to larger settlements. This limits their activities on country and associated private investment.

Landowner motivation for some activities is relatively high, linked to their high private benefit such as for food production and authority over country. Two such activities are:

1. burning, which creates habitat mosaics, and promotes availability of some plants and animals valued by landowners
2. maintenance of water sources, such as by removing silt from natural rock holes, which promotes habitat for water-dependent native animals, and which frequently also involves measures to preclude access to water by large feral herbivores.

These contemporary activities appear to produce biodiversity benefits, based on extensive observation by land management facilitators and limited research, although this conclusion has not been scientifically tested in the region. Maintenance of traditional knowledge and language through these activities, and the observational and other skills generated, also contribute to capacity for biodiversity conservation and to landowner motivation. Grant funding, often via Natural Heritage Trust (NHT), provides critical support for these activities, often in the form of coordination, plant and equipment. Paid work for landowners in these kinds of activities has also been supported by public resources through grant funds and the CDEP program.

Paid work can provide incentives for landowners to address threats to biodiversity that are not of inherent concern to them, such as weeds and high feral animal populations. But uptake of such work opportunities depends on other motivating factors being present, such as a good relationship with the program coordinator/facilitator and an appealing teamwork approach that engages customary authority structures, existing skills and knowledge.

Grant-funded biodiversity conservation projects are typically auspiced by regional bodies: the Land Management Units (LMU) of land councils and landholding bodies, or conservation non-government organisations (NGO). These typically work with local organisations and individual landowners or small family groups. Projects rely on the existence of a paid coordinator. Other key enabling factors are planning, structures for employment of community members, and 'brokers' – typically staff of, or consultants to LMUs or other agencies who link landowners to 'outsiders' with specialist knowledge or interest in aspects of biodiversity. Reliance on short-term funding and discontinuity in staffing are limiting factors. Grant funding and training resources support the development of community ranger groups in the region, particularly in the Northern Territory, with apparently valuable outcomes for youth development and biodiversity conservation.

MBI design considerations

People consulted for this study expressed strong support for a policy shift away from grant-funded approaches to conservation activities. They envisaged the best kind of market system as one in which Aboriginal landowners 'sell' their land management skills and knowledge. A strong feeling was that 'real jobs' are needed for Aboriginal people if enhanced biodiversity conservation is to be achieved and that these jobs must be generated in a way that avoids creating new dependencies or rewarding people who have not contributed to outcomes.

Contracts for biodiversity benefits may potentially be concluded with corporate landowning bodies, with individual landowners/family groups, or with third parties. In each case it is critical that the contracted party has clear authorisation/informed consent for the contract from other property rights holders. These include the corporations and land trusts that hold Aboriginal land titles in the region as common property, and family groups and individuals whose rights and duties for particular areas of land and resources are governed by customary institutions. The latter are dynamic, being constantly negotiated in relation to emerging issues and opportunities.

An effective market chain is needed to link potential purchasers of biodiversity benefits (government and industry) with producers of those benefits (individuals and family groups). Other key elements in the market chain are:

- brokers who understand purchaser requirements for biodiversity conservation (and other potentially compatible products/outcomes), and also the assets, capabilities and motivations of landowner collectives, who have clear incentives to make an effective match
- landowner collectives with capacity to deliver to contract specifications (either directly or by sub-contracting to other enterprises or individuals).

The current role of LMUs has elements of broker and of landowner collective, and they typically struggle to play both roles effectively. Increasing the capacity for landowner collectives for contracting is important. Capacity needs include: planning, workforce and resource management systems, and an understanding of the assets, capabilities and motivations of individual landowners and family groups whose involvement or approval will be needed for delivery to contract. This involves very skilled facilitation.

Community ranger group development is building biodiversity contracting capacity in some local areas. However, ranger employment is unlikely to realise the full benefits of market mechanisms in terms of cost effectiveness for purchasers, or the flexibility for landholders to integrate providing biodiversity services with other aspects of their lifestyle.

Moving beyond a job/employment paradigm to a system in which individuals and family groups are paid on a contract basis for specific services will require: long-term support for capacity building; service standards; straightforward metrics that are clear to landowners; and effective mid-level/broker organisations to support landowner micro-enterprises. The commercial bush harvest of plant foods in the region offers benchmarks in terms of straightforward metrics and communication about demand.

Outcome-based contracts for biodiversity could be developed for improved environmental monitoring, reduced feral animal and weed impacts, fire regimes directed at specified biodiversity targets, or increased populations of specified species. In each case start up investment is required to design metrics and develop landowner capacity to understand them. Measurement protocols need to engage landowners' skills and know-how as well as address scientific robustness. In addition, in cattle grazing lands on the margins of the region, landowners might trade off cattle production for biodiversity benefits in similar ways to those on pastoral lease lands (see Part 4). The forthcoming evaluation of the NT Indigenous Pastoral Program provides a potential opportunity to explore this.

Contracts directed at fire management through mosaic burning are likely to attract stronger landowner interest in this region than other potential instruments because of inherent landowner motivations. There is some risk that financial incentives for burning may 'crowd out' existing institutions – that landowners may come to expect publicly funded incentives or rewards for activities they already undertake for private benefit. However, resource limitations preclude landowner burning in much of the region now, restricting accessibility of remoter areas. Social security and CDEP policy requirements for landowners to be engaged in recognised forms of 'work' also increasingly preclude landowners committing their time to burning or other land management activities. Incentive policies that overcome such limitations would promote biodiversity-oriented fire management on a landscape scale.

Targets for landowner burning could be readily established through an adaptive management approach, starting with a specified percentage of a landholding to be burnt, over a specified period, in at least a set minimum number of patches. If such an approach is to result in effective metrics, landowners will need to understand the targets that are adopted and how to monitor their achievement. This indicates important opportunities to integrate education in use of spatial tools, remote sensing and data management – with likely strong appeal to youth.

We envisage that landowner and LMU interest in contracting for services directed at biodiversity benefits would be high because of the lack of alternative income-generating land uses across most of the region. The strong current engagement with the IPA program supports this. Landowners and LMUs across the region are likely to behave competitively in responding to an expression of interest call for provision of biodiversity services, competing for resources to manage their particular areas of country and making choices about how much private investment they will make to secure public investment. Market depth will be limited by contracting capacity, but healthy competition and learning about market engagement will be enhanced over time by networks that allow engaged or interested landowners to learn from their own and each others' successes and failures.

Recommendations

Recommendations for creating a more open biodiversity marketplace in this region are:

- support establishment of landowner collectives with contracting capacity – effective 'social enterprises' which employ landowners, particularly youth, in 'ranger' roles and provide valued mentoring roles for elders
- seek opportunities to implement micro-enterprise approaches in which individual landowners and family groups are paid on a contract basis for specific biodiversity services with flexibility in how they integrate provision of these with other aspects of their lifestyle
- aim to develop all elements of the market chain, recognising the key role of mid-level organisations and individuals as brokers for biodiversity and other compatible services (such as eco-tourism, sustainable grazing, carbon sequestration, and land condition and water resource monitoring) as part of a 'conservation economy'
- invest in capacity building through social sectors of government in recognition of the health and wellbeing outcomes that can be anticipated from well-designed programs that engage landowners more actively in management of their land
- invest in specifying priority biodiversity outcomes for the region, in parallel with a concerted program to build landowners' awareness about what other people value about the biodiversity on their lands and why
- direct investment to biodiversity outcomes that appeal to strong landowner motivations such as pride in productive country, knowledge and skills, as well as income generation
- invest in developing metrics for biodiversity benefits through fire management
- invest in developing measurement protocols that engage landowners' skills and know-how and provide scientifically robust measurement as a basis for contracting services in environmental survey and monitoring, ground-truthing of remotely sensed data and models, and for measuring other contract outcomes
- foster networks among landowners involved in these activities and promote an adaptive learning system that embeds quality assurance and feedback on performance.

1. Introduction

1.1 Aims and focal region

This section of the report identifies constraints and opportunities for more overt incentives to be applied for biodiversity conservation outcomes from Aboriginal-owned rangelands. It is a case study that forms part of the study exploring the potential for market-based instruments (MBIs) to provide incentives to landholders to maintain and enhance biodiversity in rangelands.

This case study focuses on sub-Interim Biogeographic Regions of Australia (sub-IBRAs) characterised by a very hot, dry climate and hummock grasslands (spinifex, *Triodia* spp), with a mixture of acacia and eucalypt woodlands. This area corresponds to the western part of Zone 5 (Arid Deserts) defined by Fisher et al (2004). In this report this focal region is referred to as the 'spinifex deserts' (see Map 1, below).

Aboriginal people own 64% of the land in this focal region under statutory title, long-term leasehold and/or as instances of native title which encompass strong rights to exclude others. This focal region also encompasses more than 60%[1] of the area of land in Australia where Aboriginal ownership is recognised as conferring strong exclusion rights. Titles are held collectively by groups of Aboriginal people constituted as lands trusts or corporations. The term 'landowners' is used in this study to refer to members of title holding bodies.

1.2 Market-based instruments and their design

Part 1 of this report gives an overview of MBIs and how they work (and see Whitten et al 2004). In short, MBIs are policy tools that encourage certain behaviours through market signals rather than through explicit directives such as regulation. MBIs are being increasingly used in Australian environmental management to 'reward' landowners for their investment in producing goods and services which are of broad public benefit.

In this study the public benefit of interest is biodiversity conservation. Landowners who invest time and money in maintaining and improving biodiversity generally get no reward in the market place – i.e. no higher price for the goods and services they produce. Thus they may have little incentive to manage their land for biodiversity. MBIs may provide a way for landowners to get recognition for the value of the biodiversity benefits that come from their land management practices, and may be a way to encourage landowners to manage their land in a way that produces more biodiversity benefits. The behavioural change that would be sought through an MBI in this case is in landowners' management practices, so that more biodiversity benefits are produced.

Well-designed MBIs have potential to deliver outcomes at lower cost to government and with improved flexibility for landowners than many alternative policy options (see Part 1, this report). To be effective, the behavioural change that is sought through an MBI needs to be embedded into design, as Whitten and Young point out (2004:180). Understanding landowner motivation, the appeal of different potential incentives, and how they might interact with other factors affecting

1 Our estimate of 64% is based on Pollack's (2001:29) estimate of the minimum extent of Indigenous landholdings in Australia in 2000 (1,198,302 km^2) plus native title determinations in the spinifex desert region since 2000 (263,140km^2) being determinations that accord strong exclusion rights and which encompass the vast majority of the land area of such determinations to date.

landowner behaviour is therefore critical. This case study explores these factors and their relationship to social, cultural and economic characteristics and institutions in the environment of the spinifex desert region.

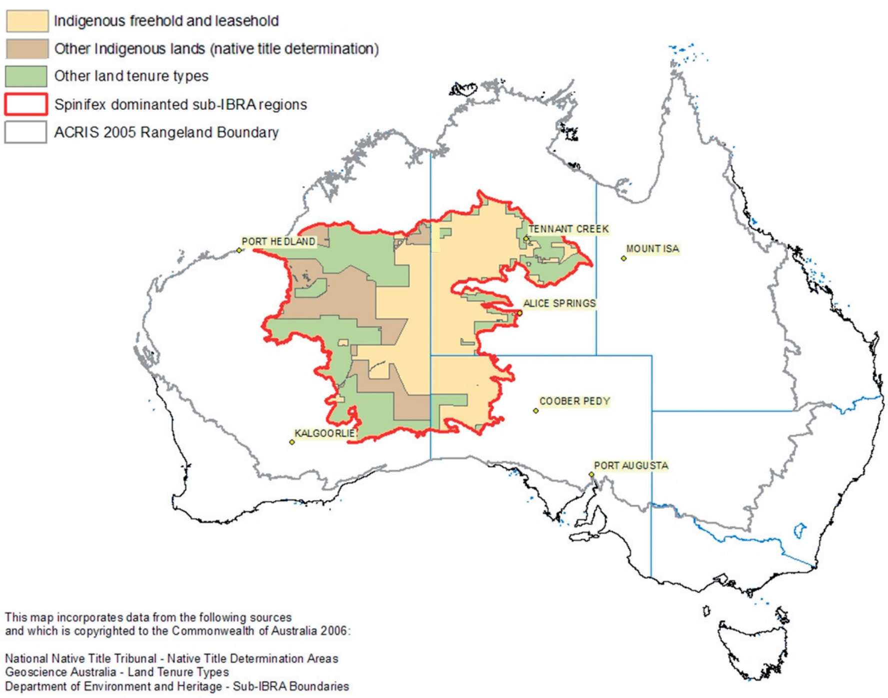

Figure 4: Spinifex desert region showing Aboriginal lands

Area: Region: 1,474,344 km² Indigenous freehold and leasehold: 677,000 km²; other Indigenous lands (native title determinations) 263,140 km²; All Indigenous lands as % of region: 64%

Bioregions (subregions): Central Ranges (CR1–3), Davenport–Murchison Range (DMR1–3), Gibson Desert (GD12), Great Sandy Desert (GSD1–6), Great Victoria Desert (GVD2–4), LSD12, MacDonnell Ranges (MAC1, 2), Nullarbor (NUL1), Tanami (TAN1–3)

NHT regions: Northern Territory, Alinytjara Wilurara (South Australia), Rangelands (Western Australia)

Design and implementation of MBIs for biodiversity benefits also depends on having good ways to measure and assess the increased biodiversity that results when landowners change the way they manage land. This requires selection of surrogates of biodiversity value, and development of a biodiversity metric. In this study the development of a biodiversity metric has focused on the Stony Plains bioregion (see Part 3, this report). Biodiversity threats and management options that provide starting points for metric design on Aboriginal lands in the spinifex deserts are considered in this case study (see Section 5).

1.3 Structure

This section sets out the approach to the case study and methods used.

Section 2 provides an overview of the natural and socio-economic characteristics of the spinifex deserts' land use, biodiversity values and threats.

Section 3 discusses Aboriginal activities on country: motivations for them; their impact on biodiversity conservation; and factors which enable or inhibit them. It draws extensively on the project workshop and other consultations. Appendix 1 provides supplementary information on three classes of activity with economic and biodiversity impacts: customary production of food; formal natural resource management (NRM) activities (including Indigenous Protected Areas and community ranger activities); and market production of bush foods. Appendix 2 describes the *Training Nintiringtjaku* initiative to develop a network of 'training brokers', which is a model with potential for adaptation to develop Aboriginal 'brokers for biodiversity'.

Section 4 summarises the strengths, weaknesses, opportunities and constraints presented by the social and economic characteristics of Aboriginal lands in the spinifex desert region for the production of biodiversity benefits through market mechanisms.

Section 5 considers key design considerations for MBIs, as applied to biodiversity conservation on spinifex desert Aboriginal lands, taking account of Part 1 of this report. Appendix 3 extends the analysis of property rights considerations.

Section 6 outlines some key structural and process considerations for developing market approaches to producing biodiversity benefits in the spinifex deserts through integrated approaches. Appendix 4 presents background information on Shared Responsibility Agreements.

Section 7 presents recommendations for development of a more open marketplace in the region.

1.4 Approach to the case study

Project consultants from Central Land Council (Nic Gambold) and Ngaanyatjarra Council (Rodney Edwards) worked with Jocelyn Davies (CSIRO) and Jo Moloney to implement this case study as a contribution to the overall study.

1.4.1 Considerations for methods

Key considerations for methods were identified by the project team at the outset of this study and are outlined below.

- The social, institutional and biophysical characteristics of Aboriginal lands are quite different from those in pastoral case study regions. This has implications both for design of a condition/intervention metric and for creating a more open biodiversity incentives marketplace.
- The cultural and institutional environment of Aboriginal lands makes testing uptake of an incentive program costly in time and money, beyond the provisions of the case study budget. Field engagement requires permit access to be approved. In some cases this requires a formalised process of prior approval by landowning groups for the research. Burdens of consultation on remote Aboriginal communities are high, raising ethical considerations for direct consultation with Aboriginal landowners at an early and tentative stage in design. Robust consultation is also costly because of the need to translate concepts between languages.
- In understanding the opportunities and constraints for MBI design there is a lot of value in engaging the expertise of people who work at the interface of biodiversity/NRM policy considerations and Aboriginal community development ('facilitators' or 'brokers').
- Concepts and language in the tender specifications and the project plan need to be 'translated' to be meaningful to such 'facilitators'. The language of 'markets' and 'production' – even terms such as 'incentive' and 'investment' – is largely absent in the operational context of Aboriginal land management. Rather, 'funding', 'relationships' and 'community needs' are the familiar concepts in the cultural and policy context within which

'facilitators' and their Aboriginal landowner clients work together. 'Shared responsibility' and 'mutual obligation' are slowly gaining currency from their use in the Australian Government's Indigenous affairs policy framework.

- Defining 'Aboriginal landowners' is not straightforward because property rights come from two systems of law in the spinifex deserts. The relationship of one Aboriginal person's rights to those of other people in a collective, and the composition of the collective, depends on context. Although the term 'Aboriginal landowners' is used throughout this report, it needs to be understood as a general gloss. Some of the complexities are discussed in Appendix 3.

The case study team's approach to the project is shown in Figure 5. The diagram incorporates the assumption that there is some overlap between the outcomes that Aboriginal people, as private landowners, want, and the public good outcome of biodiversity conservation. That is, by pursuing their own goals Aboriginal landowners will also produce some positive biodiversity conservation outcomes. This assumption is further discussed below.

Key questions that arise are whether Aboriginal landowners are producing positive biodiversity outcomes at optimal levels. Understanding both the motivations of landowners, and the factors that enable or constrain them to act in accordance with their motivations, becomes important to the design of incentives. Incentives are likely to be most effective if they promote action that helps Aboriginal landowners achieve their private goals by enhancing enabling factors or overcoming inhibiting factors in such a way that they also produce the public good of enhanced biodiversity conservation.

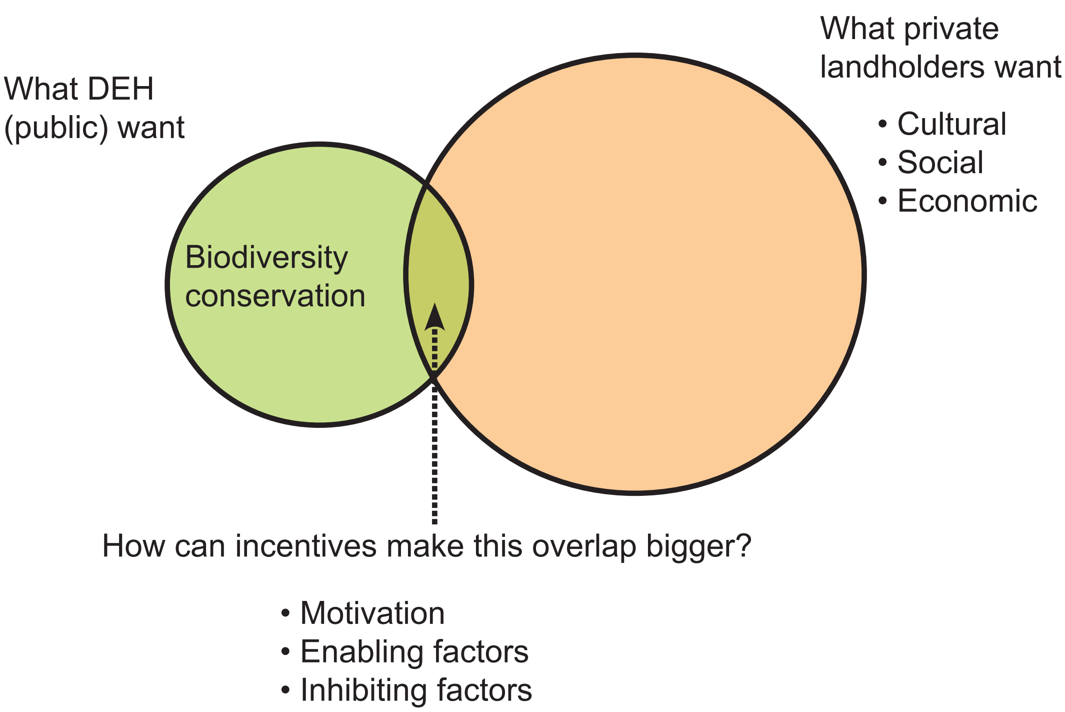

Figure 5: Project team's conceptual approach to project issues

1.4.2 Understandings of 'biodiversity conservation'

Aboriginal landowners of the spinifex deserts, and people who work closely with them as 'facilitators', have a range of understandings of 'biodiversity'. This is similar to other sectors of society. However any comparison of this case study region with other rangeland regions would be likely to reveal that this region has:

- a higher proportion of landowners who have no comprehension of the term for whom the term is meaningless
- prevalent distorted or simplified understandings of the term among many landowners, when compared with scientific understandings.

This is a function of:

- the very high proportion of landowners in this case study region who have English as a second language, with limited English vocabulary.[2]
- low levels of education and literacy among landowners in relation to western science
- a culture and world view in which people see themselves and other life forms as interrelated parts of the landscape.

Intellectuals and practitioners in the field of Indigenous land management have debated the issues arising from these cultural and world views, with calls for reconsideration of key concepts in conservation to incorporate Indigenous cultural issues (for example Langton et al 1999: 3–6; Indigenous delegates 1996). A common view expressed from these debates is that Indigenous objectives for landscape management should have priority over those of ecologists and wilderness advocates. Langton et al (2005) have recently analysed how Indigenous Protected Areas are contributing to livelihoods of Indigenous people and conservation of their biodiversity knowledge because they are community-controlled initiatives where Aboriginal landowners are able to link their land and culture with conservation on their own terms.

Rather than engaging closely with these debates at an intellectual level, this case study focuses on what Indigenous goals and motivations for landscape management mean 'on the ground' and their implications for scientific understandings of biodiversity conservation. A similar approach is taken by the Australian Government Department of the Environment and Heritage (AGDEH) in its financial support for management planning for Indigenous Protected Areas (IPAs, see Appendix 1) in that the IPA program does not require Indigenous landowners to overtly adopt biodiversity conservation as a goal. Instead it levers value for biodiversity conservation from the overlap between landowners' goals and national and international objectives for protected area establishment and management (Bruce Rose and Anna Morgan, AGDEH, project interview).

Where our work in the case study has required us to explain 'biodiversity' we have done so in terms of the definition used in Part 3 of this report. That is, biodiversity is the variety of all life forms including different plants, animals and the genes they contain, their habitats and the ecosystems of which they form a part. It can be measured scientifically through attributes such as species composition, and the functions of various life forms.

The challenge of communicating cross-culturally about biodiversity conservation is a very pertinent consideration in design of incentives. This is because Aboriginal people, like others, behave strategically in relation to resources. Good skills of 'foraging in the bureaucracy' (Young 1994) have often been 'rewarded' by grant funding. Aboriginal people are well capable of directing

2 Fifty-five per cent of Aboriginal people in the arid regions of Australia speak an Aboriginal language as their first language (Young et al 2006 in press). The proportion is much higher in the spinifex deserts because of its remoteness from towns, probably over 90%.

external financial support to their own goals, irrespective of the stated goals of the program that provides the financial support. Perverse outcomes are virtually assured if the design of interventions does not have resonance with Aboriginal motivations and goals. The risks to investors are best managed by ensuring there is mutual understanding and clear agreement on metrics for management actions and achievement measures.

1.5 Methods

Methods for the case study were:

- develop a diagrammatic explanation of the case study team's approach to the study, to guide interactions with stakeholders and approaches to the project workshop (Figure 5)
- prepare project information sheets to help the case study team communicate with people consulted as part of the case study about its aims and approach, and establish informed consent for use of information
- review recent literature and hold targeted discussions with selected individuals to identify, as relevant to spinifex deserts:
  - social and cultural characteristics that impact on biodiversity conservation
  - key biophysical characteristics that impact on biodiversity values
  - features of the current Indigenous affairs policy environment relevant to incentive structures
  - knowledge of the extent to which endogenously motivated action by Aboriginal landowners contributes to biodiversity outcomes.
- design and implement a workshop of 'facilitators' including preliminary scoping interviews with Aboriginal facilitators. Workshop design and outputs are further explained below
- review causes of market failure in relation to biodiversity conservation on spinifex deserts, drawing on workshop outputs, literature and experience in the case study team in conjunction with the MBI design expertise of Stuart Whitten and his team
- identify implications for design of biodiversity conservation incentives and MBIs, based on the above analysis and on evolving discussions in the project team.

1.6 Workshop and outputs

The workshop on 8 December 2005 aimed to:

- extend the project team's understanding and develop an analytical approach to the nature of activity by Aboriginal people 'on country'
- explore motivations of Aboriginal landowners for undertaking such activity and the factors that enable or inhibit such activity
- extend knowledge of the degree to which endogenously motivated action by Aboriginal landowners contributes to biodiversity outcomes.

These understandings are fundamental to design of incentives for biodiversity conservation. If motivation is high and the activities undertaken by Aboriginal landowners on country already support biodiversity conservation outcomes, then there is a risk of new incentives, particularly financial incentives, crowding out this existing behaviour. However, high motivation does not necessarily produce a high level of activity if there are factors that inhibit, or present barriers to, action. Hence it is also important to understand these factors.

The workshop brought together 15 ‘facilitators’ with a combined experience of approximately 200 years in professional work in, or closely related to, facilitating action by Aboriginal people for biodiversity conservation. The majority of this experience is in the spinifex desert region spanning jurisdictions in WA, SA, NT and Commonwealth (Uluṟu–Kata Tjuṯa National Park). Eastern WA and southern NT experience was most strongly represented. Discussions were not constrained to the spinifex desert region but the characteristics of that region, particularly the relative absence of livestock grazing, provided a focus.

Workshop participants were selected on the basis of their experience, interest and availability to contribute. Professional backgrounds of workshop participants include ecology, natural resource management, anthropology, geography and linguistics. Their facilitation experience and current work includes:

- research related to Aboriginal ecological knowledge and its relationship to scientific knowledge of species and landscapes and their management
- interpreting between Aboriginal landowners and non-language speakers in relation to land use and management
- planning with Aboriginal landowners, and cognate research, to support achievement of social and environmental objectives important to landholders from the lands they own and from joint managed parks
- trade in plant products bush-harvested by Aboriginal people.

Although half the workshop participants are currently employed by Aboriginal landowner organisations or government agencies, the case study team sought to draw on their professional and personal expertise at the interface between Aboriginal and biodiversity conservation objectives for land management, rather than on their role as representatives of agencies. Their employing or auspicing agencies (Central Land Council, NT Government, Threatened Species Network and Ngaanyatjarra Council) supported their involvement in the project.

Following the workshop, participants were sent a report on workshop proceedings and follow-up requests for information to assist in the case study analysis. Workshop outputs are integrated into this report, particularly in Section 3.

2. Characteristics of the spinifex deserts

The spinifex deserts essentially comprise those arid Australian rangelands where livestock grazing is not a significant land use in contrast with other rangeland regions (Fisher et al 2004). Like other arid regions these lands are characteristically a ‘boom and bust’ environment, being highly productive for relatively short periods which recur at variable intervals after erratic heavy rains. Low palatability of *Triodia* hummock grasslands (spinifex) for livestock, and absence of artesian water sources are the main factors that ultimately account for a very high proportion of the region being now in Aboriginal ownership.

2.1 Land tenure

Core areas of the Aboriginal lands in this region, at the borders of WA, SA and NT, comprise Aboriginal reserves set aside in the early to middle years of the 20th century. It is unlikely that the reserves would have been established where they were had the lands been more suitable for livestock use. These former reserves are now inalienable private lands held by traditional owner organisations under the provisions of the *Aboriginal Land Rights (Northern Territory) Act* 1976 (Cth) and the *Pitjantjatjara Land Rights Act* 1981, or they are Crown leasehold and reserves held by Ngaanyatjarra Land Council Aboriginal Corporation (WA). Other large parts of the region unsuitable for pastoralism in the Great Victoria, Great Sandy and Gibson Deserts remained in Crown tenures and were used for defence purposes. Tenures now include inalienable private lands held by traditional Aboriginal owners under the *Maralinga Tjarutja Land Rights Act* 1984 (SA), some large protected areas and registered native titles (see Figure 4).

The property rights conferred by native title in this region tend to be extensive and strong because of the relative lack of co-existing pastoral or other tenures and because occupation and practice of customs and traditions has been relatively continuous. The precise nature of these native title rights can only be established by reference to actual determinations of native title as set out in decisions of the Federal Court (see FCA 660, 1208, 1717, 1462, 1140). Only two relatively small determinations on the eastern margin of the region (Davenport Murchison and de Rose Hill, FCA 135, 110) confer non-exclusive rights. In other determinations native title encompasses variously expressed rights to:

- exclude all others in relation to decision making about the use of the land
- use resources for a wide range of needs
- control other people's access and activities.

Rights to minerals and petroleum (but not necessarily ochre, rock or soil) are universally not included in these native titles. Other specific restrictions on these native title rights in various determinations include commercial uses of water, subterranean waters, and resources that have not been used traditionally by native title holders. Other non-native title rights continue to exist, even where not specifically provided for in the determination, and native title has no effect on these rights. However such rights are very limited in this region. Determinations generally specify that native title is exercisable in accordance with state and national laws.

Because the rights are native title rights, they are exercisable in accordance with the traditional laws and customs of the native title holders. Australian jurisprudence widely recognises 'tradition' as an evolving construct rather than requiring native title holders to adhere to a 'frozen-in-time' construct of land use.

2.2 Demography and socio-economic characteristics

Overall, the settlement pattern of the spinifex desert region is characterised by a large number of small dispersed settlements with populations that are dominantly Aboriginal (see Figure 6). There are 273 of these settlements with a total Aboriginal population of 16,119, or 14,749 when Alice Springs town camps are excluded.[3] Seventy-seven per cent of the 273 settlements have populations less than 50 people and 93% less than 200 people.

3 Sourced from ABS 2001 Community Housing and Infrastructure Needs Survey (CHINS) unpublished data. CHINS enumerates the Indigenous population in discrete Indigenous settlements including Alice Springs town camps but not other parts of Alice Springs. Comparable demographic data is not available for the non-Indigenous population in the spinifex deserts region because it is not possible to readily match the areas used for population enumeration in the 2001 census with bioregional

Alice Springs, Tennant Creek and Yulara are the largest towns in the region. Many Aboriginal landowners live in Alice Springs and Tennant Creek, or in towns outside the region, notably Mt Isa, Port Hedland and Kalgoorlie. Mobility is high between small Aboriginal settlements in the region and such towns (see for example Foster et al 2006). This, together with the complex nature of Aboriginal property rights (see Section 5.1 and Appendix 3), means it is not possible to estimate what proportion of landowners live on their lands or elsewhere.

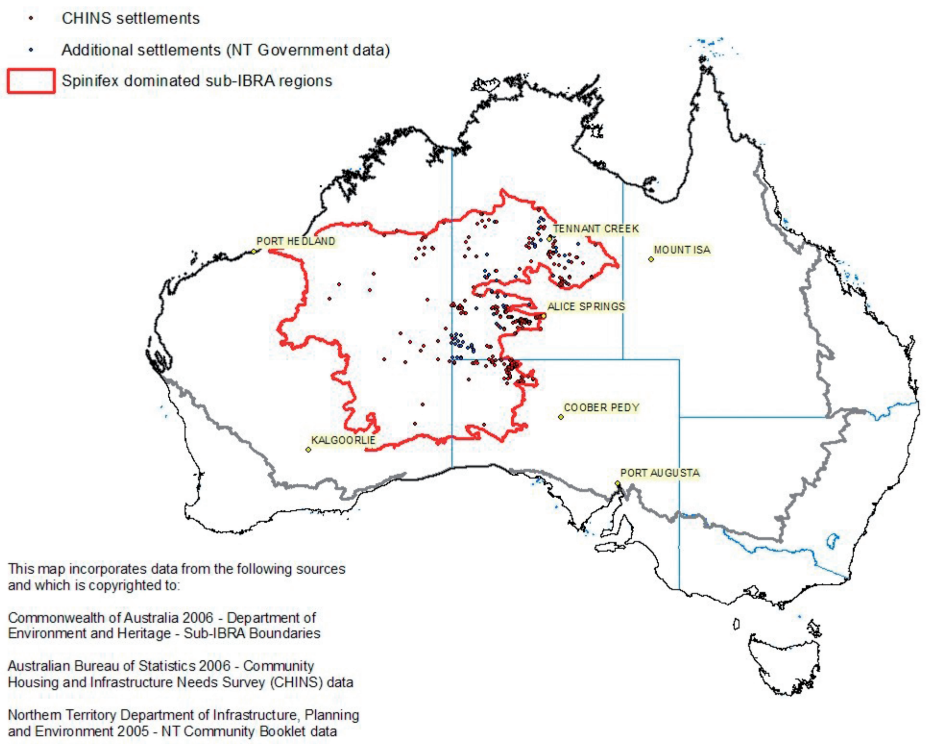

Figure 6: Settlements in spinifex desert region

The larger of the Aboriginal settlements in the region – such as Warburton, Yuendumu, Lajamanu, Papunya, Ernabella/Pukatja, Amata and Fregon/Kaltitji – were established as missions or government administered settlements starting in the 1930s. Recognition of Aboriginal property rights commenced in the 1970s. Subsequently, policy support for maintenance of Aboriginal cultural attachment to land and traditional social organisation enabled Aboriginal people to establish new settlements located on or close to places where they aspired to live because of particular cultural attachments. Some of these settlements reached a critical mass of population and services, such as Kintore/Walungurru, Kiwirrkurra, Patjarr and Watarru. Others continue as very small family-based settlements and are often known as outstations (NT, WA) or homelands (SA). In the northeast of the region some settlements are on small areas of Aboriginal-owned land excised from pastoral leases as community living areas.

There is some evidence that landowners who live on outstations/homelands are healthier than those who live in large settlements (McDermott et al 1998, and see McLaughlin 2006). But it is often very difficult for those Aboriginal people who want to live on their outstations/homelands to do so continuously because of poverty, difficult access to health and education services and

boundaries in this sparsely populated region.

the difficulties of achieving economic development given the biophysical, cultural and social characteristics of the region. Instead, they tend to use outstations/homelands as a base for periodic visits from town to their traditional country or to escape pressures associated with town life – grog, violence, arrest warrants, crowded housing, etc. A common pattern is that outstations/homelands are vacated for short-term logistical reasons, or vacated temporarily for a range of cultural reasons, and people cannot return later to live there more permanently because outstation infrastructure has collapsed due to theft or lack of use and routine maintenance.

Life expectancy in the region is considerably lower than the Australian average and the burden of chronic disease is considerably higher. For example, the standardised incidence of end stage renal disease in the region is 20–30 times the national incidence (Cass et al 2004). The population is younger than typical for Australia and growing faster, averaging 1.5% growth per annum (Taylor 2003a, 2003b; Northern Territory Treasury 2005). A 34% increase in working age Indigenous people is predicted across arid regions of Australia from 2001–2016 which will require 5,000 new jobs/income earning opportunities just to keep status quo (Taylor 2002, 2003b). This situation presents unprecedented challenges for social and economic development, especially given sparse populations, remoteness from services and the low market value of the region's natural resources other than minerals.

Base incomes of Aboriginal people are principally from welfare entitlements and part-time work in community services through the Community Development and Employment Program (CDEP) scheme. Analysis of Aboriginal incomes (Mitchell et al 2005) for the former ATSIC Central Remote region (southern NT excluding Alice Springs) is likely to be typical for the spinifex deserts. They found that average income of Aboriginal people, at $9,133 pa, is 25% that of non-Aboriginal people and dependency ratios are 10 times higher. The proportion of Aboriginal income that is irregular is high as a result of the impact of gifts, gambling, 'royalty' income (from mining production) and art sales.[4] Housing and community infrastructure is frequently in short supply and in poor condition and effective institutions for management of these assets are rare.

These socio-economic characteristics help to explain the extent to which Aboriginal people in the region tend to 'live for the moment', discounting the future, and particularly the future value of money, very heavily.[5] An example is the willingness of artists in remote settlements to sell paintings to accessible cash buyers for the price of a tank of fuel to get to town even though they may receive a thousand dollars or more for the painting in town, or if they wait for the painting to sell through their community art centre. People value immediate financial pay-offs much more highly than the prospect of future pay-offs because of:

- poverty
- high uncertainty about future pay-offs being accessible or useful due to factors such as poor health, extensive kin obligations and difficult access to services
- the prevalence of alcohol and other addictions.

This situation indicates that there are big inherent risks in policies that rely on financial incentives to achieve outcomes.

4 As noted by Musharbash 2002 at Yuendumu and analysed by Senior et al 2002 in Ngukurr community (in the NT, northeast of the spinifex desert region) who found that irregular income from gifts, gambling, and 'royalties' accounted for up to a third of household income in the period surveyed.

5 Very high degrees of hyperbolic discounting, such as characterise the behaviour of Aboriginal people in the region, have been found elsewhere to be a fundamental behavioural process associated with addiction. 'Hyperbolic discounting' refers to the empirical finding that people more often prefer smaller payoffs to larger payoffs when smaller payoffs come sooner in time relative to larger payoffs; and that when all payoffs are either distant or proximal in time, people tend to prefer the larger payoffs. These findings mean that the discount function has the shape of a hyperbola (Wikipedia entry, citing Bickel & Johnson 2003).

2.3 Land use

The dominant land use in the spinifex deserts is a mixed regime of cultural, recreation and harvesting practices, the latter being essentially a non-market, customary production typically falling outside conventional processes of economic valuation. It is supported by the state sector at least directly through Aboriginal people's use of social security payments and some CDEP resources to support these activities.

Art and craft production provides a clear example of this mixed regime. Arts and crafts are undoubtedly the Aboriginal market activities that make the strongest contribution to the economy in the spinifex deserts.[6] Aboriginal connection to the land and resources of the region provide inspiration, spiritual foundation and cultural authority for the region's many artists. In producing for art markets, they draw on customary skills, knowledge and cosmologies, and use customary techniques to harvest some natural resources. The reliance on customary skills and resources is what gives these artists a competitive advantage in the market. It also provides a fundamental motivation to artists; they are not only motivated by a desire to make money.

Other than arts and crafts, landowners use natural resources for market production through agistment grazing and other (generally small-scale) livestock production, and nature- and culture-based tourism. Commercial bush harvest of plant foods and harvest of camels are small-scale entrepreneurial activities in some parts of the region, with access to markets and the impact of irregular rainfall on supply limiting further development. A few settlements grow some food for local consumption and small-scale horticultural production of bush foods is underway in at least two places.

Three different kinds of activities on country with direct economic links for landowners and implications for biodiversity conservation are: customary production of food; 'formal NRM activities'; and commercial bush harvest of plant foods. These are described in Appendix 1. Customary production of food and use of plants for medicine remains widespread and valued but probably now contributes relatively little to local economies. Commercial bush harvest of plant foods is an activity that regularly engages Aboriginal women, particularly in the region north of Alice Springs. This is a very rare example of successful market engagement by Aboriginal landowners in the spinifex deserts that has no government or Aboriginal organisation subsidy or other support. It offers some benchmarks for market design in this region (see Section 6.2).

'Formal NRM activities' are defined for the purposes of this case study as activities related to natural resources and their use that are undertaken by Aboriginal landowners, landowning organisations or other entities with designated external funding support. Capacity for such activities and their outcomes is limited everywhere in the region by reliance on short-term grant funding and the high costs of organising and implementing such activities across large areas in a cross-cultural context. Long-term planning is difficult in part due to time frames of NHT grant cycles. There are additional uncertainties associated with changes to CDEP. Landowners and land management units (LMUs) of land councils and major Aboriginal landowning bodies use CDEP for in-kind investment for most NHT-funded activities. Overall, private financial investment in Aboriginal lands in spinifex deserts remains very limited, notwithstanding investment by mining companies, notably Newmont.

6 Various estimates of the value of this industry exist. They use different parameters for what is 'art' and apply to different regions (Altman 2003). Based on Wright and Morphy (1999–2000) the Aboriginal art industry is estimated to produce in excess of $200 million a year nationally in sales and to be growing at 10 per cent a year. Aboriginal artists in the NT are the largest producers in the industry. Their work has an estimated value of $110 million annually. Sales of Aboriginal art and crafts to NT tourists in 1998–99 totalled $48.7 million, with 70 per cent of trading done in Alice Springs (NT Travel Monitor 1998¬–¬99). This returns an estimate of $34 million pa in sales to tourists and $77 million pa from total production. Production from parts of the spinifex desert region that are not clearly within the Alice Springs market catchment (e.g. Balgo, Warburton) also contributes to the total value of the industry in the region.

A relatively high proportion of the region, 15% of its area, is managed as protected area (see Figure 7, below). Four large Indigenous Protected Areas already declared in the region by their Aboriginal landowners and one proposed in the northern Tanami desert comprise 8.6% of the region. IPA management in the region is further described as part of ‘formal NRM activities’ in Appendix 1. Several other large protected areas in the region are established as joint managed parks or are in transition to joint management.[7]

Land uses of the spinifex deserts also include mineral and petroleum exploration, with gold production in the Tanami bioregion, natural gas in the MacDonnell Ranges bioregion, nickel and other prospects in the Central Ranges and Great Victoria Desert. Statutory royalty equivalents and/or negotiated compensation payments are typically made to Aboriginal landowners, cultural custodians and other affected people as part of management of mining and exploration. Mining agreements may also include provisions related to Aboriginal employment or other socio-economic benefits for Aboriginal landowners. The 2005 MOU between the Commonwealth and the Minerals Council of Australia builds from a recent history of engagement between mining companies and Aboriginal people in the region and elsewhere. It establishes a partnership to work with Aboriginal people to ‘build sustainable prosperous communities in which individuals can build and take up social, employment and business opportunities in mining regions’. Deliverables focus on increasing Aboriginal prosperity and employability, jobs and enterprises. A Regional Partnership Agreement has now been drafted for the Tanami region.

Tourism is a significant use of the region on minor roads and tracks that traverse the region and are accessible to the public, generally with requirements for permits to access all or some of the track and surrounding areas. 4WD tourism use can be intense at accessible focal points such as rockholes which are on, or close to, major through routes.

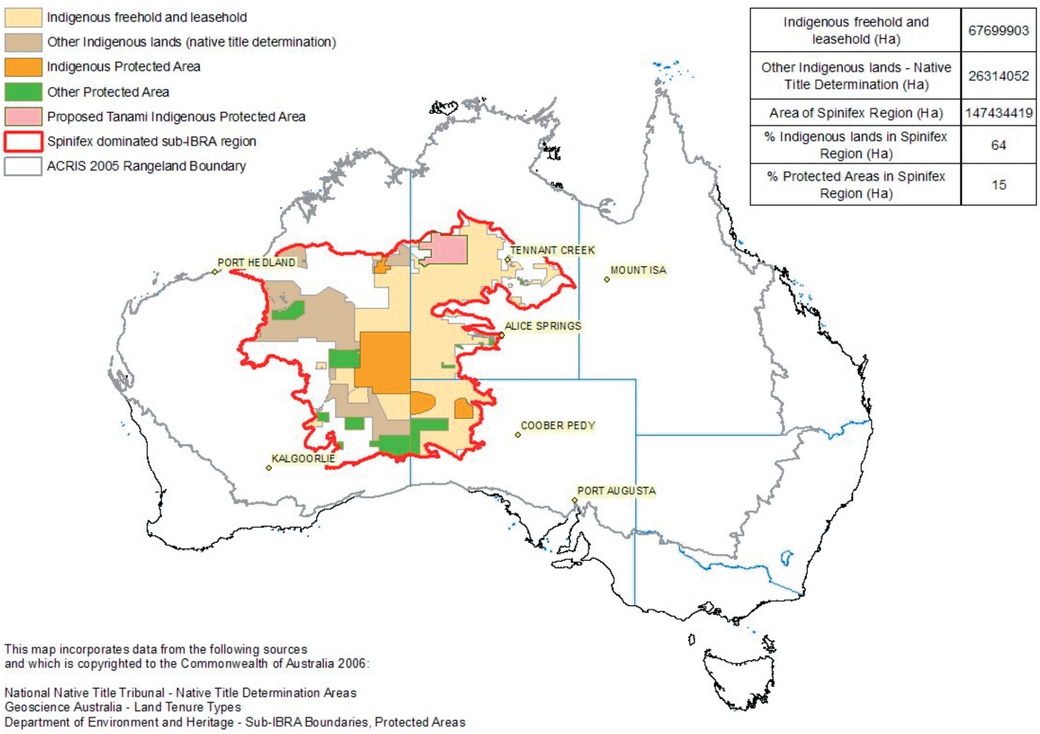

Figure 7: Protected areas in spinifex desert region

7 Apart from Uluru–Kata Tjuta National Park which was recognised as Aboriginal-owned land in 1985, approximately 5 million hectares of protected area in the NT (including Davenport–Murchison, Watarrka and Western MacDonnell National Parks), WA (Rudall River National Park, Gibson Desert Nature Reserve) and the Unnamed Conservation Park in SA are recently established or in process of being established as joint managed parks.

2.4 Biodiversity values and threats

Key biodiversity values of the region derive from the overall integrity and resilience of the landscape, extant high connectivity between habitats and capability for nutrient retention and cycling. Much of the zone contains flora with a low to moderate endemicity index, but for certain regions the index is high (e.g. Central Ranges, parts of the MacDonnell Ranges, Great Victoria and Gibson deserts). High value sites for biodiversity are set in a mosaic of natural habitats and include some wetlands of national significance. In common with the rest of the Australian arid zone, there have been significant extinctions and contractions of a range of vertebrate species, particularly mammals, but also some birds and reptiles, in the early to middle 20th century. Current trends in the condition of biodiversity appear to be relatively static by comparison (ANRA 2002–06).

Traditional knowledge has a distinctive place in this region and in national efforts to plan and implement incentives for biodiversity conservation. *The National strategy for the conservation of biological diversity* (DEST 1996) and the *National objectives and targets for biodiversity conservation, 2001–05* (EA 2001) include objectives related to maintenance of Indigenous people's ethnobiological knowledge, reflecting international instruments, notably the Convention on Biological Diversity. The relative integrity of landowners' traditional knowledge systems in the spinifex desert region (as also in the tropical savannas) provides a distinctive resource and capability for biodiversity conservation.

The threats to biodiversity in this region are different from those in other regions considered in this study because of different biophysical resources and land uses. They are also assessed differently by different stakeholders, as summarised in Table 2.

Cattle grazing, feral animals and lack of recorded information are the threats where there is most contrast between the perspectives that are prevalent among Aboriginal landowners and issues identified in formal assessments and planning. However, the contrast is masked because formal assessments and planning do now tend to take account of issues and priorities of Aboriginal landowners. This is because of the participation of Aboriginal people and organisations in planning for NRM regions and working relationships between conservation agencies and Aboriginal landowners. Also, formal plans for Indigenous Protected Areas involve collaboration between Aboriginal landowners and scientifically trained staff of Aboriginal organisations.

Only the margins of the region are used for cattle grazing and livestock grazing pressure is not assessed as a significant threat in this region. This is indicated by the high proportion of the region that is remote from water points (see Figure 8). Indeed, the region encompasses most of the sub-IBRAs that are most remote from water points. However, in some places where cattle grazing does occur on Aboriginal land in the region, institutions and the capacity to manage grazing threats to biodiversity values, and more generally to land condition, are relatively weak. Examples are in the eastern A<u>n</u>angu Pitjantjatjara Yankunytjatjara (APY) lands and in the wetlands of Paraku IPA. In the Northern Territory, re-establishment of cattle grazing on some Aboriginal lands is currently being supported by the Indigenous Pastoral Program (a partnership of Indigenous Land Corporation, NT Department of Business and Economic Development, Northern Land Council and Central Land Council). Leasing Aboriginal land for agistment grazing is being used as a strategy to re-establish infrastructure and build Aboriginal landowners' skills and governance capability.

Maintenance of water sources is seen by Aboriginal landowners throughout the region as critical to maintaining country in healthy condition. The presence of water – in ephemeral rivers and lakes, rockholes and soakages – is a very important driver of the cultural significance of places. Aboriginal people's concerns to maintain water sources also extend to the artificial water sources in the region that are used by people and/or wildlife.

Table 2: Threats to biodiversity in the region from different perspectives

Threat	Threats to country perceived by Aboriginal landowners	Threats identified in biodiversity assessments, NRM plans, IPA plans
Livestock grazing (limited to margins of the region)	Impacts on natural water sources from trampling and fouling	Grazing pressure, impacts on wetland vegetation and water quality, decrease of grazed species near water points
Feral herbivores	Impacts on natural water sources from trampling, fouling; grazing impacts on traditional resources e.g. yarla (bush yam, *Ipomoea costata*), quandong (*Santalum acuminatum*)	Grazing pressure and impacts on natural water sources; camels chasing away other game.
Feral predators	Concern not widespread; landowners may recognise predation impacts on threatened species where they have been involved in research or formal NRM programs	Significant causal factor in decline of critical weight range mammals and ground nesting birds
Weeds	Where buffel grass is widely established (e.g. Alice Springs area), landowners note competition and changed fire regimes resulting in decline of bush food species.	Localised impacts on other species e.g. buffel grass and *Parkinsonia*. Impacts of buffel grass on biodiversity through changed fire regimes are becoming recognised as a major threat in parts of the region.
Changed fire regimes	Concern from elders about uninformed, inappropriate use, and about lack of burning in areas not visited or where burning is excluded by pastoral land use. Buffel grass fires impact on bushfoods.	Use of prescribed fire to re-establish habitat mosaics; protection of fire vulnerable species/ ecosystems by establishing fire breaks
Degradation of natural water sources	Prime concern, linked to cultural/spiritual values of water sources and concerns about water availability for animals and people. Cleaning out silt, and fencing to exclude ferals, are significant activities in formal NRM programs.	Impacts on flora, aquatic fauna from trampling by feral herbivores, siltation, fouling by faeces.
Tourist use	Desecration of rockholes, caves, rock art sites, totemic sites through unauthorised access.	IPA plans aim to manage tourist/visitor use.
Depletion of valued resources through human use	Sporadic concern about depletion of accessible craft woods.	One of several factors explaining decline of valued game species in Anangu Pitjantjatjara Yankunytjatjara (APY) lands; resource depletion zones identified around major settlements in Ngaanyatjarra IPA plan
Loss of traditional knowledge; discontinuation of customary practices	High concern among elders about sedentary lifestyles in settlements eroding knowledge of country and other capabilities for discharging customary management; extinctions and declines of valued species linked to decline of customary practices, including ceremony.	With respect to changed fire regimes, concern to record knowledge and improve transmission.
Lack of systematic recorded information about resources, condition and trends in condition	Not a concern. Conversely, data collection by others raises landholders' concerns about loss of control over resources and over use of traditional knowledge.	Significant concern for understanding threats and outcomes from management interventions.

Sources: NLWRA 2002, ANRA 2002–06; NRM plans and investment strategies for NT and Alinytjara Wilurara regional NRM Boards, Management plans for IPAs in the region, AWS 2005, McFarlane 2005, tacit knowledge and experience of authors and project consultants.

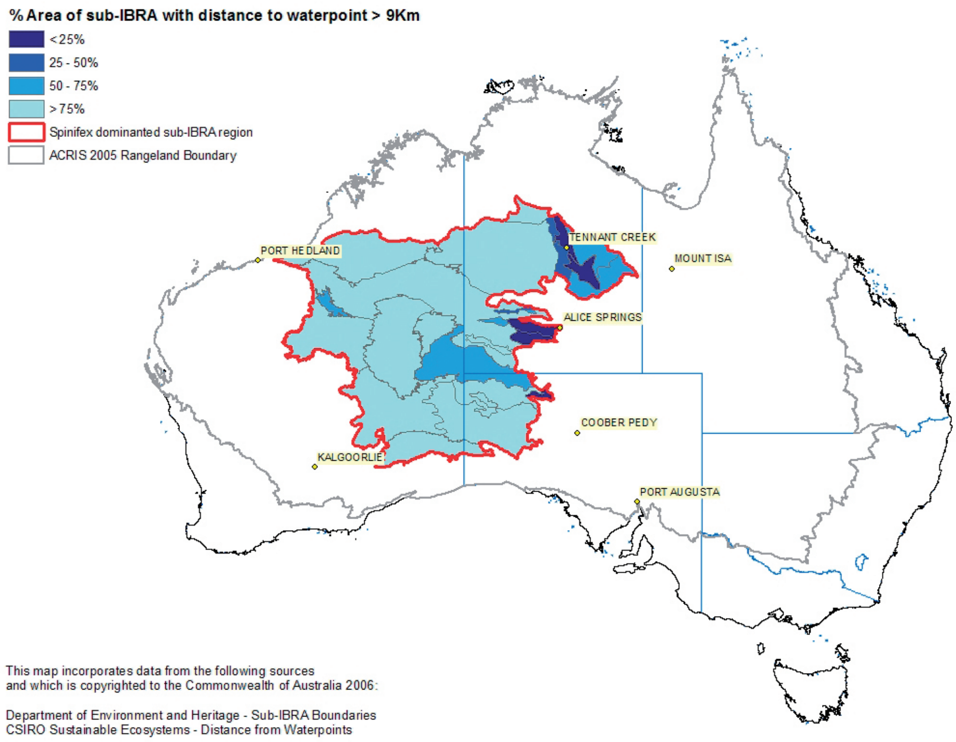

Figure 8: Distance to waterpoints for sub-IBRAs in spinifex desert region

The contrast between Aboriginal people's attitudes to feral animals and those of conservationists or scientifically trained land managers is frequently noted. Cultural norms of respect for animals extend to feral animals (see CLC 2005a, Rose 1995) and generally lead Aboriginal people to object to 'shooting to waste', rather than using animals. When Aboriginal people perceive that feral animals are impacting on valued resources they act to protect those resources. In this region, this tends to happen when feral herbivores are impacting on water sources, as the following quote indicates:

> *Anangu don't have a grasp of the significance of the numbers of camels and their impact. They don't see camels as a problem because they keep moving and the grazing impacts are not concentrated in one place ... And nothing bad will happen if they do or don't kill the camels. NRM issues like camels do not carry the same sort of duty [of care] that people have had since they were kids. Camels are more prevalent round rockholes and you can see the impact, for example when camels get stuck in rockholes. Here it is the impact on the place that is significant, so Anangu make a concentrated effort to exclude camels from rockholes. This also relates to their fear that something bad will happen if the rockhole is not looked after.*
>
> Project interview, Aboriginal NRM facilitator

Landowners widely consider feral animals to have economic value because they use some species for food (rabbits, cats) and medicine (e.g. fox by Warlpiri people) and because some people engage in small-scale commercial harvesting, especially of camels in the west MacDonnell ranges and APY lands. Other camel innovation is taking place at Docker River where landowners have been experimenting with harvesting camels for food to improve nutrition in the community, and they aspire to larger scale commercial harvest. APY LMU has developed a proposal for harvesting for pet meat and related markets.

Enterprises based on harvesting camels or other feral animals will not necessarily produce biodiversity benefits since harvest is most efficient when populations are relatively high. Production of biodiversity benefits needs to be addressed as an integral part of enterprise development and management if these are to be achieved.

Aboriginal landowners of the spinifex deserts who have worked in collaboration with scientifically trained land managers do come to appreciate why feral animal control programs are important, and then they advocate for them. This has particularly been the case in relation to feral predation on threatened species populations where scientific collaborators have given strong messages about feral animal threats and landowners can observe evidence of predation. Nevertheless, landowners are rarely strongly motivated to cull ferals themselves, although they may be comfortable to authorise other people, including LMU staff, to do so and to involve young people or ranger groups in this work. Debate about proposals is important to landowners understanding the rationale for them, as illustrated by the discussion about donkey control in the proposed Davenport Ranges National Park, NT (see Nano 2005). Conflict between Aboriginal landowners and others about feral animal control programs is always assured if landowners have not been an integral part of the decision-making process.

Weed threats are also not well appreciated by many Aboriginal landowners. The incidence of alien plants is relatively low in much of the region, but high in some areas such as the Burt Plain IBRA. They are of concern to landowners in some situations, such as where buffel grass is spreading along creek lines from areas around settlements where it was used for revegetation, as in the APY lands. In areas where buffel grass is well established, notably in the vicinity of Alice Springs, Aboriginal landowners express concern about the impact it has had on bush food resources, including through changed fire regimes.

3. Motivations, behaviour and biodiversity benefits

Design of incentives needs to take landowners' motivations and resultant behaviours into account. Aboriginal people often have deep motivations that underlie activities they choose to do, or get involved with doing, on country. These motivations are rarely expressed in conventional planning approaches, but are often expressed subtly and in seemingly simple language when activities are undertaken in the presence of questioning 'whitefellas'. A number of factors influence, inhibit or enable the prospects of people acting on their motivations to undertake 'activities on country'. The question of whether those activities produce biodiversity outcomes is also central to this study. These issues are discussed below, drawing on project workshop outputs.

3.1 Motivations

Project workshop participants described motivations that they consider lead the landowners they work with to undertake 'activities on country' – i.e. activities that landowners undertake away from towns and the region's larger Aboriginal settlements. Table 3 below summarises the motivating factors identified by participants for various activities. We have grouped most of these activities into customary, formal NRM, and enterprise. There are also smaller clusters of 'mixed' activities, where customary and formal NRM components are typically hard to separate, and of activities associated with social development and maintaining access.

Participants identified 32 motivations for landowners to undertake these various activities (see Table 3). These motivations can be broadly categorised into six areas:

1. spiritual and cultural identity and expression (9/32)
2. social links (2/32)
3. health (2/32)
4. teaching and using traditional knowledge (8/32)
5. economic production (sustenance and potential income generation) (7/32)
6. escape from social pressure (4/32).

Table 3 indicates that the overall strongest motivators are related to identity and pride, health and income generation. Social and cultural motivations are strongly represented in Table 3 highlighting the vast difference in views between western and Aboriginal constructs of the values of land. Motivations related to family, cultural connection to country, enjoyment, identity, and health, form an interconnected cluster related to 'health and wellness/wellbeing'. Aboriginal representations of this include Arrernte elder MK Turner's poster *Everything comes from the land* (Turner n.d.).

'Species increase (through ceremony)' and 'keeping people and country healthy' are indicated in Table 3 as reasonably strong motivators for Aboriginal people to undertake activities on country. Spiritual and cultural identity, teaching and use of traditional knowledge are significant motivators for elders because their whole identity is often bound into country. Children who grow up speaking their Aboriginal language have an aptitude for learning about country because so much of the language derives from country. However, elders express concern that without strong contact with their county, the children do not learn appropriate language and also are never 'literate' because they cannot 'read the country'.

Table 3: Aboriginal activities on country and motivations

MOTIVATIONS

Cultural (& self) identity	Cultural continuity	Cultural expression	Recognition of ongoing connection to country (cultural authenticity)	Expression of ownership – right person, country, story	To keep people & country healthy, strong, safe and productive	Maintain kin relations with people & country	Fear of consequences (cultural/spiritual)	Species Increase (ceremonial way)	Family connection	Family relationship	Physical health	Spiritual health & healing	Teaching children	Story telling	Pride in use of country	Pride in knowledge	Feedback on knowledge and skill (pride & validation)	Passing on knowledge	Help outsider with request	Use of specialist tools & skills	Fear of consequences (administrative)	Sustenance (food & medicine resources)	Protecting physical assets	Money/income generation	Enjoyment	Achieve qualifications	Improve future employment/develop skills	Getting away from white fellas	Getting away from urban pressures/humbug	Because you can	Overcoming boredom	No of motivations
spiritual & cultural identity									social links		health		teaching & use of traditonal knowledge								economic production (including sustenance & potential income generation)							escape from social pressures				
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spiritual & cultural identity									social links		health		teaching & use of traditonal knowledge								economic production (including sustenance & potential income generation)							escape from social pressures				

Most activities shown in Table 3 have 10 or more motivators. The highest proportion of motivations is engaged by some of the customary activities (teaching kids family way, gathering bush tucker, and travelling and being on country with kids) and social development activities (isolating kids from negative influences on settlements through diversionary programs, and school programs on country). Some formal NRM activities such as threatened species management and bush trips with agencies engage a relatively high number of different motivations. Others such as weed and pest control do not.

Workshop participants considered there to be no link between scientific concepts of threats to biodiversity and factors that motivate Aboriginal landowners to be on and do activities on country. Biodiversity threats such as feral animals and weeds are management issues outside of the customary context and very rarely fit with Aboriginal people's internal or primary motivations. This is indicated in Table 3 by the low number of motivations that these activities engaged. LMUs have to be proactive to support action on these issues in other ways. This is usually through paid work in ‘formal NRM activities’. However in some places, such as where there is a high proportion of the population who are on pensions, it is hard for LMUs to use employment as an incentive.

Workshop participants commented that some things such as weed control just don’t happen except through paid jobs and organised work programs. However once some action is underway, other motivators related to landowners’ connections to country can kick in to help these initiatives keep going.

Walsh’s (2000) analysis of issues/aims raised by 199 landowners in Central Land Council (CLC) land use planning workshops from 1996–1999 is also instructive. This is a sample of landowners who are strongly committed to living on or close to their lands. The findings show clearly that these landowners want work: when combined, three classes of issues/aims – ‘ranger work and training’; ‘work’; and ‘earn income’ are the most commonly raised. These findings do not give a lot of insight into what landowners mean by ‘work’. However, Walsh observes that the way issues were raised indicated that these landowners see work as beneficial in itself, not just as a source of income. Landowners are mainly interested in work that fits in with their cultural and community responsibilities. Moving to where jobs are available is a lifestyle choice with little appeal considering the other issues/aims that are very important to them such as collecting bush foods and ceremony.

Workshop participants noted that young adults’ work in formal NRM activities is valued, unlike many other jobs available to them through CDEP, such as picking up rubbish. The nature of the work generates pride and this becomes a motivator. Young people involved in community ranger work motivate other young people because they have a good time doing the work, laughing and swapping yarns. These are powerful motivators for young people from remote settlements. For young people living in towns, who are often not language speakers, having a job is the motivator and pride comes from having one.

Participants noted that there are age cohorts who are ‘missing’ from engagement with their country. In the Ngaanyatjarra lands, people in their late 20s and 30s are often the ‘missing group’ in activities on country. Recognising short life expectancies, they may be considered ‘middle-aged’ and are at-risk socially and in terms of health. Strong motivation by elders in some places to get these people out on country more and to develop opportunities for these people to work in formal NRM projects indicates they are investing social capital into this group. In contrast, in the places where community ranger groups are being established in the NT, people in their 20s and 30s form the core group of participants. Here, people in their 40s and mid 50s are less actively involved. In some situations, when budget limitations for NRM work have been discussed, older people have determined that employment opportunities should go to young people.

Cattle grazing was not a prominent issue in discussions at the project workshop because of the nature of participants’ experiences and characteristics of the areas where they work. Nevertheless, strong motivation and interest in running cattle among some landowners on the margins of the region must be recognised as a potentially significant issue for biodiversity conservation. Walsh (2000) reports ‘managing cattle’ as the aim/issue most often raised by male participants in CLC land use planning workshops from 1996 to 1999. Landowners’ motivations may include a conviction that ‘cattle belong to the country’ and that the country is not being properly managed without them (Mark Ashley, NT DPIFM & DKCRC pers. comm.). Income from agistment grazing can also be an important motivator, as appears to have been the case in the extension of agistment grazing into the eastern APY lands in 2002–2006 through informal agreements between agisters and individual landowners that were not sanctioned by the landowning collective.

3.2 Do Aboriginal activities on country generate biodiversity conservation outcomes?

Since Aboriginal landowners have strong inherent motivations to do activities on country, it is important to understand to what extent these activities produce biodiversity outcomes. This is discussed below. The focus here is on customary Aboriginal practices (such as harvesting, patch burning associated with harvesting or cultural imperatives, increase ceremonies (ceremonies to maintain or increase animal or plan populations), and social controls on land use at sacred sites). The extent to which 'formal NRM activities', as currently undertaken, generate biodiversity conservation outcomes is also an important consideration for policy. However evaluation of these is outside the scope of this study.

The biodiversity impacts of contemporary customary Aboriginal activities on country are uncertain as there are few empirical studies, particularly in the spinifex deserts. It is widely acknowledged that customary Aboriginal practices contributed to the evolution and maintenance of a productive economy based on local natural resources and landscape function (see for example Latz 1995a, Yibarbuk et al 2001, Bird et al 2005). The extent to which natural resources were consciously managed for long-term sustainability is frequently debated (for example Flannery 1994, Latz 1995b, Rose 1996, Bird et al 2005). Nevertheless, it is widely recognised that pre-European production was managed through strict social controls that encompassed access to knowledge and resources and use rights. Via these classical institutional arrangements Aboriginal people significantly influenced ecosystem and species diversity in landscapes they lived on and moved through. It is much less clear how contemporary customary activities on country now impact on biodiversity in the spinifex deserts. Examples outlined below indicate that there are some positive impacts, and also show how scant empirical evidence is in this region.

3.2.1 Threatened species and outstations

Some ecologists who have worked with Aboriginal landowners on threatened species survey and recovery planning in the spinifex deserts hypothesise that some species are more likely to now be found near outstations. The ecologists reason this is likely because some of these species (like tjakura or Great Desert Skink, *Egernia kintorei*) are mobile and have a habitat preference for relatively recently burnt areas, and a fine grained mosaic of burnt areas is more apparent close to outstations. Also they reason that high densities of dogs living at outstations deter or kill foxes and cats, and predate less on the threatened species than the foxes and cats do. Aboriginal landowners also hunt the foxes and cats. Even though landowners might also hunt the threatened species near outstations, the overall impact of people is positive. This hypothesis has not been tested (pers. comms. Steve McAlpin, Pip Masters 2005/06 and see Griffin and Allan 1986).

3.2.2 Gendered activities

Women's customary activities on country are an important consideration which is sometimes overlooked by the dominance of men in many formal NRM activities. Recent research by Bird et al (2004; 2005) with Martu landowners leads them to conclude that moderate and regular burning has a big impact on women's hunting success which motivates women to burn, whereas the impact on men's hunting success is not marked. Commercial harvesters of bush plant foods, all of whom are women, are also reported as burning to enhance production (see Appendix 1).

3.2.3 Fire management

Fire management is a key consideration for biodiversity conservation in this region. Research suggests that there is a relatively good match between Aboriginal landowners' motivations and practices associated with fire, and biodiversity conservation in the spinifex deserts. But this match is not reflected in collaborative fire management at a landscape scale in the region. The value of contemporary Aboriginal fire management practice in producing biodiversity benefits is limited because Aboriginal burning is only occurring along the region's sparse road network.

Customary Aboriginal burning in the spinifex deserts was associated with a fine-grained mosaic of habitats in relation to age since fire, which has been 'obliterated in recent times and replaced by a simpler mosaic consisting of either vast tracts of long unburnt and senescing vegetation or vast tracts of vegetation burnt by lightning-caused wildfires', as Burrows et al (2004: 1) found in Western Australian spinifex deserts. In addition to lightning as a source of ignition, Aboriginal landowners still burn in the spinifex deserts. They use fire frequently and regularly for many reasons – to acquire food, to 'clean up the country' and for purposes they describe as 'cultural' (e.g. see Burrows et al 2004, Bird et al 2004, 2005, Vaarzon-Morel et al 2006).

Participants in the workshop for this project reflected on their own and other people's concern that most of this Aboriginal burning now happens along roads, and sometimes quite indiscriminately, without care, knowledge or any purpose connected with use and management of natural resources. But Aboriginal landowners, at least in the southern Tanami, have been found to be unconcerned about the large number of roadside ignitions. Instead, they are concerned about lack of 'cultural burning' in areas that are not accessible by road. While accepting that lightning strike fires are part of the cultural order, they also have a fear of destructive wildfires (Vaarzon-Morel et al 2006).

Analysis undertaken as part of DKCRC Desert Fire research shows 80% of ignitions in the southern Tanami region between 1997 and 2005 were within a kilometre of a road. There were 3,000 fires during this period. Most were in spinifex dominated vegetation and almost certainly lit by Aboriginal people. Only 2% of fires were large; these accounted for 70% of the area burnt in this period. They were fires lit in September–October, whereas most fires were lit in July–August (Allan 2006).

In vegetation types that are not dominated by spinifex, fires tend to occur only when rainfall is more than 120% of the long-term average (Allan 2006). This is when there is most risk of large, intense fires, which impact negatively on pastoral enterprises on the margins of the spinifex deserts. Such fires are also considered to have a significant negative impact on biodiversity values, as they generate uniform habitats in relation to age since fire, whereas expert opinion advocates small-scale fires that generate different size and age patches to create a variety of different habitats (Gabrys 2006).

Bush tucker production has been highlighted as an activity that engages a wide range of motivations for Aboriginal landowners, including money/income generation in the case of commercial bush harvest (see Table 3 and Appendix 1). Fire plays an important role in regeneration of the ten or so key species that continue to be harvested today, with harvest success being dependent on appropriate fire regimes (Latz 1995a, Gabrys 2006). Commercial bush harvest stands out as a market activity that Aboriginal landowners are extremely motivated to undertake and that can result in biodiversity benefits. These benefits are likely to result where repeat engagement with the industry over several years leads landowners to manage fire in a way that promotes production. However the market is small and production focuses on key species growing close to roads in the parts of the region that are relatively close to towns.

3.2.4 Capacity for biodiversity conservation

Involvement in customary activities on country, such as burning, does not in itself motivate Aboriginal people to address identified threats to biodiversity (e.g. weeds, ferals) or to undertake burning in a way that is targeted at biodiversity conservation. But workshop participants strongly expressed the view that when Aboriginal landowners have been involved in formal NRM projects that address threats to biodiversity, then their understanding of these threats and their motivation for biodiversity conservation has grown. This process can be seen in Nano's (2005) account of discussions about donkeys in the Davenport Ranges. Nesbitt et al (2001) describe it happening in the APY lands in relation to fox threats to rock wallabies. Vaarzon-Morel et al (2006) report on the strong interest from Warlpiri landowners in sharing information with others about their fire management and learning about scientific knowledge and concerns related to fire and its management. Facilitators/brokers working in formal NRM activities have many further stories about changes to Aboriginal motivation for biodiversity conservation through involvement with scientists and conservation managers. This increased capacity is a positive outcome for biodiversity conservation.

Maintenance of traditional knowledge can also be considered an outcome for biodiversity conservation because it maintains capacity for biodiversity conservation. It does so by generating motivation for Aboriginal people to maintain relationships with their traditional country. Customary activities on country generate landowners' observation skills, experiences, and familiarity with landscapes and their biota. The experience of participants in this project is that these elements contribute to capacity for biodiversity conservation, even though they are not motivated by biodiversity conservation objectives and scientific understandings of biodiversity (cf Moore et al 2006: 367).

The languages of the spinifex desert region have a distinctive role in capacity for biodiversity conservation. Language embodies much fine-grained ecological knowledge of the behaviour of species, characteristics of resources and practices such as burning. Sedentary lifestyles on settlements and the marginal contemporary economic value of country mean that language about country is becoming redundant, and less and less widely known. Unless language about country, and the ecological knowledge it contains, regains economic value it will continue to be lost to biodiversity conservation.

Formal NRM activities provide a contemporary context for traditional knowledge, language, authority and skills to be expressed. They engage some of the same motivating factors as customary activities (see Table 3) with added incentives of paid work for some people and/or opportunities to get out of settlements and onto country.

3.2.5 Cattle grazing

The re-establishment of cattle grazing in the margins of the region has a mix of implications for biodiversity conservation. On the one hand, livestock grazing is identified as a threat to biodiversity (James et al 1999, Landsberg et al 1999, 2003 and see Parts 3 and 4 of this study). On the other hand, planning for the re-establishment of grazing presents an opportunity to consider impacts on biodiversity, and grazing infrastructure and work opportunities may bring positive benefits in terms of capacity for biodiversity conservation. Capacity may be increased because improved infrastructure (notably bore and fenceline access tracks) and work opportunities lead to landowners having better access to their country, enhancing their observation and knowledge about the condition of country, and facilitating customary food production and associated burning.

3.3 Are biodiversity benefits being produced at optimal level?

The discussion above suggests that customary Aboriginal activities on country do continue to support biodiversity conservation in some circumstances. Formal NRM activities can be expected to add to these outcomes, including through actions targeted at biodiversity conservation objectives.

Biodiversity benefits are not currently being produced at an optimal level through customary Aboriginal activities on country because of a number of limiting factors. Those identified by project workshop participants are outlined below. Participants also described factors that enable biodiversity benefits to be produced through formal NRM activities. Design of effective incentives for biodiversity production needs to be informed by an understanding of these enabling and limiting factors.

3.3.1 Factors that limit Aboriginal activity on country

Activity on country is limited because it now has relatively little economic value for Aboriginal landowners. Economic value is necessary for culture and biodiversity to articulate. Also, landowners do not have the means to access their country (transport, fuel) while they have no viable economy.

Other major limitations on landowners enhancing biodiversity outcomes by engaging more in any activities on country relate to human and social capital. These include:

- ill health
- the trauma and distraction of social stress (petrol sniffing, marijuana, youth suicide, alcoholism, domestic violence, welfare dependency) and the high load this puts on carers
- loss of elders/teachers due to early death
- lack of people with driver’s licences or the ability to get one
- other interests/commitments, e.g. football means people are often away from their home base for four or more days a week in football season
- high mobility resulting from many factors including social stress, accessing health and education services, social obligations, and attractions of town life.

Some limitations relate to physical capital/infrastructure:

- dysfunctional stores – irregular opening hours and poor quality food which complicate the logistics of getting out from settlements onto country
- lack of appropriate (or any) vehicles
- limited vehicle access to country, e.g. rugged remote areas.

3.3.2 Enablers for formal NRM activities

Any formal NRM activity needs a coordinator. As well as their logistical role, relationships with coordinators can be important motivators for Aboriginal landowners. This is indicated by the motivation in Table 3 of 'helping outsider with request'. Together with other individuals and organisations who act as 'brokers' between landowners and others, coordinators are key enablers for directing Aboriginal landowner interest and effort to biodiversity conservation outcomes. This broker role, and other important enablers, are discussed below.

Brokers

People who work in intermediary roles between remote Aboriginal people and 'strangers' are critical as enablers for biodiversity conservation. Some such people have trusted relationships with particular Aboriginal landowners that have been built up over many years of interaction even though they are 'outsiders' and hence not part of the 'community' or collective of landowners. These people have various formal roles – they may be staff of Aboriginal organisations, government, or NGOs; researchers; consultants; NRM facilitators; elders; or community leaders. It is the quality of their relationships that makes them critical enablers for formal NRM activities, and often also for facilitating customary Aboriginal activities on country. The significance of such people in communication and governance in and in relation to remote Aboriginal communities has been poorly recognised (Batty 2005, Moran 2006).

Some NGOs and a few private sector organisations are in this mid-level role in relation to biodiversity conservation. NGOs include the LMUs of landowning bodies and of CLC, Tangentyere Council (through its Landcare and Land for Learning programs), Greening Australia and the Threatened Species Network. Landowners' trust in such organisations comes from their track record and in some cases from their formal accountabilities to landholders. Ultimately, however, it is the individuals within such organisations who have the critical role as enablers.

Social network analysis terms such people 'boundary spanners' or 'brokers' and establishes that they have a key role in connecting hubs of activity (see Burt 1992, Straton and Gerritsen 2006). They can be very powerful in that they have great influence in connecting landowners to 'strangers' (people who are quite external to the landowners' own social networks), in introducing new information or ideas, and in fostering consequent innovation.[8] Mobilising social capital and related community assets in ways that generate outcomes that are important to external parties always depends on the existence of such brokers (Pretty 2003a, 2003b).

In the context of biodiversity conservation, external parties or 'strangers' are often the people with specialist land management skills or interests, e.g. fire specialists, weed specialists, NHT coordinators. AGDEH is an external party in terms of its specialist interest in biodiversity conservation outcomes. But staff in the AGDEH Indigenous Protected Area (IPA) program have a direct and trusted relationship with some IPA landowners which means they are in a broker role in those landowners' networks.

A key role of brokers is to interpret the objectives and interests of external parties into concepts and language that are meaningful to Aboriginal landowners and vice versa. This is a challenging task because of the difference in world views between landowners and external parties. For

8 In anthropology, people in this broker role are called 'gatekeepers'. This is no longer a useful term in relation to Aboriginal landowners because it has acquired the pejorative connotations that gatekeepers always keep gates shut, ignoring their critical role in opening gates.

example, when external parties with a biodiversity conservation interest come to remote Aboriginal settlements talking about fire, weeds and ferals, they may be greeted by blank faces unless there are brokers to interpret this into concepts and language that are familiar locally.

Brokers are trusted by Aboriginal landowners because they understand and comply with landowners' social norms, use local knowledge and services, and have local economic impact. Landowners expect their relationship with brokers to bring them benefit, and ongoing trust depends on that outcome.

Engagements between external parties and landowners depend on how the brokers who are part of landowners' social networks judge the opportunities and risks. Brokers carry responsibility for how external parties behave in relation to Aboriginal landowners' interests. If external parties breach protocols or fail to deliver on promises they have made, landowners hold brokers responsible.

Brokers must be able to foster good relationships with external parties if they are to be effective as brokers. Hence it is an article of faith for people in this position that when they are part of transactions that lead to Aboriginal landowners being allocated resources for a particular purpose, they must ensure the resources are used for that purpose. The broker's own livelihood may also depend on this, for example where a grant allocation part funds their own salary. This accountability to external parties can put brokers in difficult situations, such as when landowners want to use a land management vehicle for transport to a funeral. Brokers have to judge whether their relationships and accountabilities to landowners or to external parties are more important.

The strength and resilience of networks between landowners and external parties interested in biodiversity conservation depends on the qualities of people in broker roles. These networks are vulnerable when non-Aboriginal people in broker roles fail to maintain good relationships with landowners or when they change jobs or move from a community. The latter happens frequently, given the short-term nature of funding for formal NRM activities in the region, and the stress of remote area work. Conversely, Davies et al (1999: 83) identified that one of the factors accounting for the effectiveness of community-based natural resource management initiatives in three northern Australian settings was the relatively long-term commitment (5–10 years) by individuals in broker roles.

Few of the people in broker roles on Aboriginal lands in the spinifex deserts are Aboriginal landowners from that region. Building more capacity, particularly Aboriginal capacity, in broker roles for biodiversity conservation is critical to fostering communication between Aboriginal landowners and outsiders and to developing structures that enable effective contracting for biodiversity outcomes. Waltja's *Training Nintiringtjaku* initiative, described in Appendix 2, offers a model. This current initiative, which is building a network of Aboriginal brokers for training, is being extended to broker roles for research in collaboration with DKCRC. As discussed in Appendix 2, it may also have potential as a model for Aboriginal people to be engaged as brokers for biodiversity conservation.

Planning and plans

Planning by landowning bodies and associated organisations is important for many reasons:

- as a basis for coordinators and agencies advocating for the aspirations of landowners
- as a vehicle for external parties to understand and recognise efforts and outcomes, thereby promoting informed investment
- to keep corporate memory and bridge discontinuities in individual people's involvement.

Plans can be designed to ensure that traditional knowledge, skill and perspectives are appreciated, understood and built in. Examples of this can be seen in IPA planning. For communication among Aboriginal landowners, plans always needs to include videos and community 'plain English', or language texts and pictures.

One plan is not enough. Strategic planning needs to be developed for cross-sectoral issues (including health, education, culture, infrastructure, community administration and environment). For environmental issues, a planning system needs to include a plan of management (5–10 years, setting out values), strategies for key issues/initiatives (3–5 years), and annual action plans. An example of a multi-tiered planning system is that developed for the proposed Tanami IPA (see Box 1, below).

The process of planning is critical to building capacity, learning and adaptive management.

Box 1: Planning for the Lajamanu Indigenous Protected Area

The Lajamanu Indigenous Protected Area (IPA) plan and the structure provided by community ranger groups are important enablers for the proposed Lajamanu IPA to address biodiversity conservation and other objectives. The current IPA proposal comprises most of the northern Tanami. There is also a proposal to investigate the feasibility of a contiguous IPA covering the southern Tanami.

The four main (Warlpiri dominated) settlements in these areas have been working to establish local community ranger groups: Yuendumu, Nyirrpi, Willowra and Lajamanu. CLC supports these endeavours, working with local organisations in the development of appropriate projects, work programs and sustainable structures. Examples are Yuendumu CDEP and Wulaign Resource Centre at Lajamanu, both of which are organisations that also act as resource agencies for local outstations.

The CLC approach is to use the IPA as a 'brand'. It is a very attractive brand for the landowners. Even if the funding coming through the IPA program was only $10,000 per year, ranger groups would still want an IPA for the kudos. The aim is to get recognition from the outside world and public support to secure additional resources for land management. Recognition from within the community is an extra spin-off but is not the main aim of the IPA plan.

Planning for the proposed Lajamanu IPA is hierarchical:

- **Community plan** – things that are important to landowners and the Lajamanu community (e.g. training and education for young people, football, health outcomes, reducing violence, maintaining culture, protecting sites)
- **Strategic plan** – how to address as many of these issues as possible in integrated, coordinated ways. The first recommendation is to establish a community ranger program, working to a relevant land management plan, i.e. the IPA plan.
- **Business planning** – for the community ranger groups. These ranger groups are being set up as commercial enterprises within the settlements where they are based. Business-style planning is the enabler for attracting investment from diverse sources and for the groups to contract to provide services. The estimate is that 20–35% commercial income could make this business viable given other investments via Natural Heritage Trust, CDEP, the Aborigines Benefit Account established by the *Aboriginal Land Rights (Northern Territory) Act* 1976 and other sources. Mining environmental works undertaken for Newmont Mining's Tanami operations are currently the main commercial component of the Wulaign Ranger program.
- **IPA Management Plan** – a long-term prescription for management of the IPA, including definition of the natural and cultural values of the region, management issues by key management zone, requirements for traditional landowner consultations, and appropriate decision making, monitoring and evaluation mechanisms.

Source: Nic Gambold, CLC.

Achieving effective participation and inclusivity so that planning has these outcomes is a particular challenge in the spinifex deserts given distance, communication costs, language diversity, landowner mobility, and staff turnover. Planning also needs to be integrated into action if it is to build commitment and catalyse change rather than just being seen as 'talk that goes nowhere'.

Formalised planning is mainly undertaken by people in broker roles to support communication and coordination between landowners and outside agencies. Few spinifex desert landowners really understand this communication and coordination process or the way that outside agencies work and there is no coterie of Aboriginal 'anthropologists' dedicated to explaining these things to their own society. This lack of understanding means that, no matter what level of participation has been achieved in planning, Aboriginal people's own priorities may not be well reflected in the process and the resulting documentation. Workshop participants commented that Aboriginal landowners need to be able to allocate money to things they see as important if planning is to contribute to a resilient and self-sustaining system. If resources are only allocated through a program structure, they are already distributed to things that non-Aboriginal people see as important.

This point is illustrated by two examples of spinifex desert landowners' use of untied money allocated as a small part of a major land management initiative. Having the capacity to implement their own priorities was critical to Aboriginal landowners developing a real sense of ownership of the land management initiative. In one example, Aboriginal people chose to use the untied money to fund art teachers because they saw their art as important to their land management activities. In another example, Aboriginal people used the untied money to fund travel to planning meetings for people with traditional rights and responsibilities but who live a long way from the area being managed.

Structures

Structures are necessary for implementing plans and evolving plans. They are critical in addressing the administrative details of employing and paying people and managing vehicles/transport in formal NRM activities. Providing structured opportunities for landowners to get involved in formal NRM activities can lead to greater participation in these activities but this is not assured given alternate motivations and the limiting factors discussed above.

Effective structures need to engage customary Aboriginal institutions, such as by involving elders in positions of cultural authority. They need to accommodate landowners' broader aspirations for health, culture and economy. Structures such as community ranger groups recreate a relevant context for traditional knowledge and skills. They provide pathways for young people to work with and help elders in achieving their aspirations for their land.

Structures may be internal to a landowning group or external to it, as long as the relationship and accountabilities are clear. Internal structures include family-based corporations and may include community councils. External structures are those provided by organisations in broker roles (see section 3.3.2).

Innovation is important in considering the design of structures. In formal NRM activities most attention has been directed to community ranger groups and land management centres. A micro-enterprise approach which engages individual landowners and their families in addressing threats to biodiversity on their traditional lands warrants closer exploration. The management of Walalkara IPA is one example of this latter approach in the region .

3.3.3 Limitations on formal NRM activities

Financial constraints are a major limitation on achieving outcomes for biodiversity conservation in the spinifex deserts. Project workshop participants consider that until there is better recognition by Australian public and taxpayers of the importance of biodiversity conservation, everything is scratching the surface. An order of magnitude shift is needed in funding if biodiversity threats are to be addressed in the spinifex deserts. For example, Denis Mathews, who was ranger at Finke Gorge National Park for 15 years with a staff of five rangers, estimated it would take 30 people to manage burning in the park and 40 people to control buffel grass (pers. comm. to Fiona Walsh CSIRO, 2005). It is also estimated that if the APY lands, which encompass some 10 per cent of South Australia, had the same budget per hectare as Uluṟu–Kata Tjuṯa National Park, its fire management budget would be $30m annually (Jock Morse, pers. comm., 2005).

Lack of continuity in policy and long-term support is a significant limiting factor for formal NRM activities. Project workshop participants noted that although aspirations of Aboriginal people for their country are similar to what they were 10 years ago, support mechanisms have kept changing. Participants also noted the dearth of research or understanding about what works and what doesn't. A focus on effective programs is needed to build understanding. Yet there is no benchmarking, little feedback on performance, and not enough reward and celebration for achievement.

The difficulties of achieving a coordinated approach to looking after country were discussed by workshop participants. They consider that working across sectors is important because formal NRM activities can achieve integrated outcomes for health and wellbeing as well as for NRM outcomes.[9] At the local level, cross-sectoral collaborations can work very well but they are extremely difficult to achieve when they require any authorisation or support from higher levels of agencies. Problems for collaboration also relate to limited understanding of contemporary land management issues both from the scientific and Aboriginal perspective. This leads to lack of shared vision and limited effort to make significant use of Aboriginal people's knowledge and skills. Collaboration is also not advanced when people in broker roles unduly filter ideas and issues as they translate them between landowners and agencies.

Stress and burnout of community leaders and landowners in paid employment is an issue. It arises when people are under pressure to perform and/or to be involved in 'all' programs. All of this amounts to 'too much humbug from 'whitefellas'.

A related factor is insufficient priority or commitment for funding to employ Aboriginal landowners in positions where they can lead and coordinate NRM activities. This adds to the pressure on the few people who are in this position. Literacy and numeracy hinder appointment but could be overcome with greater long-term support and mentoring including career structures. Capacity to undertake formal NRM activities is also limited by lack of accommodation in remote settlements, making it hard for LMU staff from outside the landowner group, as most are, to be based on site.

9 See Burgess et al (2005) for a review of evidence supporting this assertion.

4. SWOT summary

The social and economic characteristics of Aboriginal lands in the spinifex desert region for the production of biodiversity benefits are summarised in Table 4 in relation to significant strengths, weaknesses, opportunities and threats.

Table 4: SWOT summary of spinifex desert Aboriginal lands' social and economic characteristics in relation to production of biodiversity benefits

Strengths	Weaknesses
Landowner skills and knowledge of species and ecosystems, including knowledge embedded in language	Parochialism – landholders don't know how others value their country
Some aspects of biodiversity are highly valued by landowners	Landowners are not culturally attuned to the need for active management in order to maintain valued resources
Inherent landowner motivations to do activities on country	No strong scientific evidence base about which activities on country enhance biodiversity benefits
	Under-developed structures for market engagement or contracting for services
	Widespread low motivation and confidence for action – linked to poverty, poor health, welfare dependence and failed initiatives
	Low landowner priority for NRM activities due to time demands of settlement management and accessing services
Opportunities	**Threats**
Culture embeds an economic link to some biodiversity resources which is a motivator	Limited knowledge and management skills for addressing contemporary threats to biodiversity
Dispersed distribution of population, in proximity to some key biodiversity resources	Vulnerability of outstation resource agencies, and the community ranger groups they host, to changes in CDEP and other government policy
Large scale of Aboriginal landholdings	Long timescale needed to build landowner capacity, compared with ongoing and urgent threats to biodiversity resources
Landowner motivation to do activities on country and to work provides point of engagement with biodiversity conservation priorities	Capacity limitations on government partnering in effective intersectoral approaches
Landowner interest in piecemeal, part-time work fits the profile of demand for biodiversity management actions	Lack of resources or will to support both local livelihoods and key broker roles
Collaborations with scientists in IPA management and Natural Heritage Trust (NHT) funded projects have fostered capacity for biodiversity conservation through networks, planning and work experience	
Some LMUs with extensive NHT2 experience, familiar with working to targets	

5. Design issues for MBIs

This section considers issues for the development of approaches that engage Aboriginal people, as private landowners, in biodiversity conservation in the spinifex deserts using market signals. It addresses some key design considerations for MBIs (as identified in Part 1 of this report) in relation to the social, economic, cultural and environmental context of Aboriginal lands of the spinifex deserts as described above.

Consideration of these design issues has been guided by the directions that project participants considered to be feasible. They expressed strong support for a policy shift away from grant-funded approaches for formal NRM activities. They envisaged the best kind of market system as one in which Aboriginal landowners ‘sell’ their land management skills and knowledge. A strong feeling was that ‘real jobs’ are needed for Aboriginal people if enhanced biodiversity conservation is to be achieved and that these must be generated in a way that avoids creating new dependencies or rewarding people who have not contributed to outcomes.

We envisage that an achievable market-based instrument would involve a voluntary contract between government (and/or other purchasers) and Aboriginal landowners. The contract terms would provide for financial support matched to landowners’ achievement of biodiversity benefits through undertaking management works. A market approach to contracting assumes that competition among potential providers of these biodiversity benefits, such as through tendering, will allow purchasers to decide where they will get the best value.

5.1 Property rights

Aboriginal owned lands in the spinifex deserts are characterised by complex property rights which present considerable challenges and risks for contracting for biodiversity benefits. Table 5 (below) summarises these characteristics in relation to the attributes of property rights that enable trade (see Murtough et al 2002).

In particular, property rights of individuals and of the collectives they belong to both need to be taken into account in contract design because of the interface of statutory and customary institutions in these lands. Individual landowners’ property rights in customary law as members of the collective are dynamic and constantly negotiated in relation to emerging issues and opportunities. Contracting for biodiversity benefits will act to enhance the authority of contracted landowners in relation to others. This will have a positive impact for biodiversity conservation provided contracted landowners are not solely motivated by the material resources due to them for contracting, but also have some inherent motivations from relationship to country and a desire to see their traditional country well cared for. The interface between statutory and customary institutions also means that the duty of care of landowners in relation to biodiversity is even less clear than on other rangelands. These issues are discussed further in Appendix 3.

The identity of the contracting party needs to be clear: Is it the body that holds title to the land? Is it an individual or family group (or a corporation so constituted) with customary rights and responsibilities for part of that land? Either option is possible but both options need to address the relationship between the property rights of individuals and of collectives because:

- A title-holding body that contracts to produce biodiversity benefits must have effective mechanisms – social controls or enforceable by-laws – to ensure that its members use the land in ways that are consistent with the contract.
- The rights of individuals or family groups (including family-based corporations) to determine how land is to be managed need to be recognised and authorised by the title-holding body in order for those individuals/family groups to be in a position to contract.

A third option would be to contract with a local/community government council, resource agency, land council or some other non-government organisation for services which produce biodiversity benefits. Such organisations must themselves have effective mechanisms for contracting with the title- holding body, and the title-holding body must have effective controls in relation to the way the land is used by its members, including how it is used for customary activities where these might impact on biodiversity benefits.

Table 5: Considerations for contracting for biodiversity benefits on Aboriginal lands in relation to desirable attributes of property rights to enable trade

Characteristic	Description	Considerations for contracting for biodiversity benefits
Clearly defined	Nature and extent of property right is unambiguous.	Effective contract with collective landholding group requires that the group can manage how the overlapping and dynamic rights of its individual members, as determined by customary law, are exercised. The rights of the collective landowning group are ambiguous in relation to society's expectations for use and management of land and resources, as expressed in statutes.
Verifiable	Use of the property right can be measured at reasonable cost.	Cost is high due to inherent difficulty in measuring relationship between landowners' actions and biodiversity benefits. Additional costs are incurred by cross-cultural contexts and 'overlapping' property rights.
Enforceable	Ownership of the property can be enforced at reasonable cost.	Enforcement of biodiversity contracts difficult due to overlapping property rights and cross-cultural context. Collective must have effective social or other controls where individual members' actions may impact on contract outcomes.
Valuable	There are parties who are willing to purchase the property.	Demand for biodiversity benefits is not clear. Main interest is from government (e.g. IPA program), sometimes brokered through regional NRM boards and NGOs. Specific biodiversity outcomes that are in demand are often not clearly specified.
Transferable	Ownership of the property can be transferred to another party at reasonable cost.	High costs generated by the need for collective decisions by landowners about the implications that contracting will have on other property rights of the collective and its members.
Low scientific uncertainty	Use of the property right has a clear relationship with the desired outcome.	High scientific uncertainty about relationships between interventions and biodiversity outcomes given the stochastic environment. Interventions based solely on traditional knowledge and practice also have uncertain impact on biodiversity, especially in relation to contemporary threats.
Low sovereign risk	Future government decisions are unlikely to significantly reduce the property right's value.	Where government is the purchaser, the value it places on biodiversity in one place will be reduced if it can conserve comparable biodiversity more efficiently somewhere else. Capacity of Aboriginal landowners to produce biodiversity benefits is dependent on government decisions, e.g. about services to remote settlement services and activities allowable under CDEP. Any government decisions that effectively raise the duty of care required of Aboriginal landowners for biodiversity will reduce the value of contracts.

Source: Property rights characteristics and description from Murtough et al (2002).

Thus the design task for incentives for production of enhanced biodiversity on Aboriginal lands has at least two tiers:

A. Design of mechanisms to enable the collectives who hold property rights to Aboriginal lands to trade in biodiversity benefits, such as by contracting to produce specified outcomes or to undertake specific works

B. Design of institutions that harness the activity of individual members of the collective through a system of social controls so that activity is directed at the outcomes the collective has contracted to produce.

Design task (A) faces similar considerations as design of incentives for biodiversity outcomes in other rangeland areas. It requires attention to metrics and to factors such as the number of sellers of biodiversity services necessary to generate competition in an artificially created market where the government may be the sole buyer of biodiversity services.

Design task (B) greatly extends the complexity of the task. Establishing social controls can be costly (in time, social capital and financial pay-offs) but is critical for sustainable use of collectively owned natural resources (see for example Ostrom 1990, 2005; Agrawal 2002; Rose 2002). In contemporary Aboriginal Australia re-establishment of effective social controls for land use is part of the governance challenge that is a pre-eminent issue for very many remote Aboriginal communities and landowning groups.

5.2 Information asymmetries

Government and landowners have very different information about resource condition. Aboriginal landowners' knowledge of resource condition in the region is from observation, resource use and cultural practices over time. It is increasingly concentrated in relatively small and clustered parts of the region and along road corridors. Government agencies' knowledge is best developed from remote sensing (e.g. fire) and in some places from one-off sampling as part of biological survey (e.g. Robinson et al 2003).

Landowners have very little information or understanding about what other people value about their land. Governments do not have good information about how landowners use and manage the land, how landowners may be able to change their management in order to enhance biodiversity benefits, or of the costs of those changes. Governments have less information than in some other rangeland regions because they are not monitoring land condition and undertaking extension activities as they do in pastoral regions.

Lack of information, lack of sharing of information, and lack of shared understanding about what information means, are part of the problem for achieving enhanced biodiversity conservation in the region. Shared understanding is important because landowners will not change the way they use and manage the land unless they understand and agree with the reasons why governments and scientists say biodiversity is important. Conversely, Aboriginal landowners do change their views about the value of biodiversity resources and about threats to biodiversity through interactions with trusted people who hold views different from their own, and through their own first hand observations (as discussed in section 3.2.4).

Landowners who spend a lot of time on their country observe changes and trends. The additional value of systematic data collection is that it can link across temporal and spatial scales. It can generate understanding of the direction of change in a system. Landowners need to be part of the data collection process if the data is to generate understanding of the threats that others perceive to biodiversity resources and of different management options.

Trust, observation and effective communication are key foundations for establishing shared understanding of threats to biodiversity conservation and what action is required to address them. Experiences of unauthorised appropriation of resources, including traditional knowledge, heighten Aboriginal landowners' fears that providing information about resources or about their own behaviours will lead to them losing control of those resources or to other curtailment of their freedoms. Further challenges arise from Aboriginal landowners' economic dependency on government. Information distortions result from Aboriginal people guessing what government people want to hear, and tailoring information to suit in order to be left alone ('no more humbug'), or strategically in anticipation of personal gain.

We suggest that these information asymmetries can be used positively in concert with implementation of contracts for biodiversity conservation services, and in concert with development of contracting capacity (see Section 5.4.1).

5.3 Risk of crowding out customary institutions

A market-based approach will be inefficient if it 'crowds out' customary institutions that may already be effective in achieving biodiversity benefits. This is happening now to some extent through grant-funded formal NRM activities. Where LMUs and structured community ranger groups are established, some landowners begin to see it as the responsibility of those groups to maintain the country in good condition, such as by burning and cleaning out rockholes. Whereas previously landowners themselves burnt because it was a customary practice and responsibility, now landowners in some places expect that they will always be paid for burning.

5.4 Biodiversity threats and management options

Desired biodiversity outcomes need to be clearly established as part of implementation of any MBI. Without this there is no basis for establishing which opportunities to contract will be most cost effective. There has been relatively little investment in establishing priority biodiversity outcomes in the spinifex deserts from a scientific/conservation perspective or from that of landowners. Moving from the broad understandings of threats to biodiversity conservation in the region discussed in Section 2.4 to a clear specification of priority biodiversity outcomes is a significant and necessary task for a market-based approach. Collaborative methodologies that engage landowners in survey and planning and use visual and graphical tools and informed interpreted dialogue (see for example Walsh and Mitchell 2002) are critical to establishing shared understandings of threats to biodiversity.

Incentives will have least risk of crowding out behaviours and customary institutions that already support biodiversity conservation if they are directed at threats that are not widely appreciated by Aboriginal landowners in the region and which Aboriginal landowners have little private incentive to address. Significant such threats are: lack of systematic recorded information; and feral herbivores and predators (see Table 2). Weeds, changed fire regimes and cattle grazing are also pertinent. Potential approaches are discussed below.

5.4.1 Information – environmental and management monitoring

The gaps in biodiversity information in the spinifex region present opportunities for designing incentives targeted to enhance the information base for conservation management. The basis of contract outcomes in this case would be provision of data that meets specified protocols and standards, either for survey of biodiversity resources or for monitoring condition of resources or threats such as feral animal populations and establishing trends.

Financial incentives for data collection would re-establish links between landowner effort and economic benefit from the land. Contracts for data collection would provide resources for landowners to get out on country. Implementing these contracts would require that landowners visit parts of their country where they might not normally go, due to: distance; lack of vehicles; because the areas involved are not valued by landowners for food, cultural significance or other reasons; or because there is no-one who now holds clear customary authority for the area.

While they are out on country, landowners will invariably do many other things apart from data collection, because of the inherent and customary motivations that have been discussed in Section 3.1. They will typically hunt and gather food and medicines, teach children about country, burn, visit cultural sites including natural waterpoints and undertake minor maintenance. These activities will also contribute to biodiversity conservation targets, such as through maintenance of traditional knowledge, and increasing habitat diversity through burning. Landowners' observation of impacts on valued resources from feral animals and weeds will enhance motivation and commitment to act on addressing these impacts.

Data collection protocols that draw on traditional practices, observational skills and methods of assessing the health of valued resources will be most meaningful to landowners. Collaborative biological survey has a very good track record as a mechanism for engaging scientists and Aboriginal landowners in shared understanding of biological resources and biodiversity values. Within this region the biological survey of the APY lands conducted by the South Australian Department for Environment and Heritage (SADEH) and APY, the landowning body, over a ten-year period with Commonwealth funding support (Robinson et al 2003), and the Uluṟu fauna survey (Reid et al 1992, 1993) each established a foundation for enduring interest and action by Aboriginal landowners in addressing threats to biodiversity conservation.

Measurement techniques for monitoring the trends in condition of biodiversity that have good potential to be used simply and consistently for data collection by Aboriginal landowners include catch effort logs, rockhole condition and tracking transects. These are now in use by researchers and LMUs in their work with landowners in the spinifex desert (e.g. Paltridge et al 2005), sometimes incorporating icon-based data entry to PalmPilots. McFarlane (2005) outlines some design considerations for use of these in the monitoring protocol for the Watarru sanctuary in the APY lands of South Australia. Apart from their inherent value as ways of engaging landowners' skills, such techniques express a demand for traditional knowledge, promoting its value and incentives for its maintenance among younger generations and thus contributing to national biodiversity targets. These measurement options also lever off and thereby validate and value the customary duty of care of landowners towards the land and resources since this is embedded in traditional practices.

Design of data collection protocols requires start-up investment. Quality assurance is an important consideration for the data provided it is to be comparable across space and time. Contractors will need to be trained in the techniques to be used, and validation trials should be undertaken as part of quality assurance. Payments linked to achievement of specified standards of data collection could provide incentives for landowners to improve their skills. Data collection, analysis and collaborative consideration of implications can also contribute to broad scale understandings of environmental change among landowners[10] and thereby promote resilience in social-ecological systems. These are not, however, outcomes that can be achieved by Aboriginal landowners alone.

10 The Arctic Borderlands Ecological Knowledge Cooperative is an example of how Indigenous people are using data they collect in local settings (in this case qualitative data on harvest and resource abundance) and data from others to inform learning about environmental change at many scales and develop adaptive responses (see Eamer 2006).

They also need investment in scientists and coordinators/facilitators to work with Aboriginal landowners to design methods and quality assurance procedures, and investment in building capacity for landowners to contract and deliver to contract specifications. These issues are further addressed in Section 6.

5.4.2 Threatened species populations

The most straightforward opportunity to introduce market mechanisms may be in relation to management of discrete threatened species populations. Locations have been reasonably well identified through threatened species recovery planning. Management by landowners in collaboration with LMUs already involves monitoring, feral predator control and patch burning for wildfire protection at some sites. Market mechanisms could have appeal if they overcome the limitations of current grant funding mechanisms – their short term nature and the difficulties that some LMUs (notably in WA) experience in accessing regional Natural Heritage Trust (NHT) funds. Outcome-based contracts – for increases in threatened species populations – would give flexibility to landowners in how they achieve this. However contract design would need to account for scientific uncertainty and impacts on threatened species populations resulting from variable seasonal conditions that are unrelated to management, as discussed in Part 1 of this report in relation to risk and risk management.

5.4.3 Feral herbivores

Some Aboriginal landowners are strongly motivated to harvest camels, donkeys and feral horses for sale, particularly where elders have a tradition of working with cattle. As discussed above, cultural and economic values that landowners ascribe to feral animals mean they have little motivation to cull them.

A bounty for culled camels might provide an attractive incentive for landowners, overcoming some Aboriginal people's objections to shooting to waste which culling proposals generally encounter. Uptake of such a proposal would be limited by shortage of high powered firearms and of licensed shooters in the region, and constraints on landowners with criminal convictions becoming licensed shooters. These could be potentially overcome by mentoring individuals as shooters from a young age, using a micro-enterprise model.

The approach would need to be designed to ensure that camels are not 'bred for the bounty' and that semi-domesticated animals on Northern Territory (NT) pastoral stations, where camels are being increasingly co-grazed with cattle, are not shot for the bounty. Improved environmental monitoring (see above) would help target culling to areas where there are the greatest threats to biodiversity resources. Development of radio frequency ID (RFID) 'smart tag' technologies (see, for example, Silverthorne 2004) would appear to hold promise for design, or even off-the-shelf purchase, of an inexpensive identifying device that would record kill location if activated at the time of kill.

Potential may also exist to address biodiversity benefits as part of the implementation of camel harvesting operations and proposals in the region (see section 2.4). All these proposals struggle to achieve commercial viability because of harvesting and transport costs and poorly developed markets. Financial incentives or bounties could potentially be paid for harvesting effort that reduces populations to defined levels in identified priority areas. The current NHT-funded camel project coordinated by DKCRC provides an opportunity to pursue these options.

5.4.4 Fire

Fire is in an ambivalent position in relation to introduction of incentives for biodiversity benefits. This is because Aboriginal landowners in the region have strong private motivation to burn, suggesting that introducing incentives risks crowding out customary institutions. For example if community ranger groups are paid to burn, and come to be perceived by other Aboriginal landowners as the new caretakers for fire, the people who currently are burning because of cultural or other private motivations may cease to do so (Gabrys 2006).

On the other hand, if burning is purely considered to be a 'private activity' of landowners, without any overt recognition of the public good it produces for biodiversity conservation, it is becoming increasingly difficult for landowners to engage in it (Vaarzon-Morel pers. comm., 2006). This is because 'private activities' are not considered to be 'work' and government institutions through which landowners get paid social security benefits – their main regular income – increasingly require landowners to be engaged in 'work'. An incentive structure aimed at promoting customary burning also needs to address physical constraints, such as the existence and condition of roads and tracks in very remote areas, and landowners' access to vehicles that are suitable for this terrain.

A further important consideration is that burning may either threaten or enhance biodiversity conservation depending how it is done. This suggests incentives need to be developed in conjunction with planning that identifies priority areas and times to develop fuel-reduced zones as fire breaks for biodiversity purposes. This could involve reducing fuel load and risk of wildfire where there are valued fire-vulnerable species or habitats or where spread of buffel grass carries the risk of frequent high intensity 'buffel fires' resulting in local extinctions of shrub species. Expert opinion concludes that it is critical that everyone is aware of the need to burn straight after large rains so fuel loads – and the extent of fires – do not get out of hand as they did during the most recent above average rainfall years in 2001–02 (Gabrys 2006). Development of incentives in relation to these kinds of specific fire management goals will be best pursued in conjunction with fire management planning such as is being currently undertaken by LMUs and NRM boards in several parts of the region (including Ngaanyatjarra lands, APY lands, southern Tanami, Alinytjara Wilurara NRM Board).

Because Aboriginal landowners are strongly motivated to burn and landowner burning has a high likelihood of benefiting biodiversity, market-based incentives related to burning are likely to attract stronger landowner interest than those directed at other threats to biodiversity conservation such as weeds, feral animals and information collection. Targets for landowner burning could be established through an adaptive management approach, starting with a specified percentage of land to be burnt, over a specified period, in at least a set minimum number of patches.

If such an approach is to result in effective metrics, landowners will need to understand the targets that are adopted. An ongoing focus on capacity building is required to achieve this understanding, as well as to enable concerted attention to fire management during periods when there is a high risk of large fires. Given the well developed spatial understanding of their country that landowners in this region often have, the meaning of metrics based on fire regime could be developed fairly readily (compared with some other measurement tasks) through training in GPS, mapping and use of Google Earth.

Establishing the relationship between biodiversity, burning and carbon sequestration in spinifex deserts would open new sources of investment to support such activity, through greenhouse gas offsets, as has been achieved in western Arnhem land (Horstman 2006). However, this relationship is not at all clear in the spinifex deserts and the scientific challenges to understanding it are more complex than those for savanna rangelands due to the stochastic rainfall.

5.4.5 Weeds

Spread of buffel grass is the main current weed risk to biodiversity. Relatively few Aboriginal landowners perceive the risks and there is very little capacity in the region to address them. Incentives for information collection, as discussed above, would have potential to promote greater understanding of these threats, among landowners and agencies.

5.4.6 Cattle grazing

The small proportion of landowners in the spinifex region who graze livestock are in a position to trade off the financial returns from livestock with those they may get from a biodiversity conservation market. However, care is needed in introducing conservation incentives where livestock grazing is opportunistic and unauthorised by landowning bodies (as in much of the eastern APY lands) as this would effectively be rewarding people for rule-breaking. Care is also needed to avoid policy conflicts that could result from applying market-based conservation incentives in areas where government and Aboriginal organisations are working with landowners to re-establish managed grazing on Aboriginal lands as an economic development strategy (as in the NT margins of the region under the Indigenous Pastoral Program).

As noted above (section 3.2.5), reestablishment of cattle grazing has some potential for biodiversity benefits. There may be potential for market mechanisms to address threats to biodiversity in similar ways to pastoral regions considered in other case studies, such as by trading off agreed stocking rates with payments to landowners or lessees for biodiversity benefits. These issues would best be addressed in the spinifex deserts in conjunction with the implementation of the Indigenous Pastoral Program and an evaluation of the program's outcomes to date which is scheduled to begin in late 2006.[11]

5.5 Potential market participation

Landowners in this region have very few options to earn income from their land. This makes the opportunity to contract for services that enhance biodiversity outcomes potentially attractive to them. On this basis we envisage that landowner and LMU interest in contracting for services directed at biodiversity benefits would be high. The record of voluntary establishment of IPAs in the region supports this. However this lack of alternative land use options also makes it difficult to envisage how an artificial biodiversity market could function effectively: there is no basis for competition if government is the sole likely purchaser[12] and most sellers have no effective choice.

Potential participation in a market is also strongly constrained by contracting capacity. In the current situation, LMUs and conservation NGOs are likely to be the main organisations that would respond to an expression of interest (EOI) for provision of services directed at biodiversity benefits.

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11 The evaluation is being managed by Desert Knowledge CRC in conjunction with the 21st Century Pastoralism project led by Mark Ashley of Northern Territory Department of Primary Industries, Fisheries and Mines.

12 This is not to discount potential industry investments. Corporate support for biodiversity conservation outcomes from Aboriginal lands in the region is now most clearly expressed in Newmont's involvement with CLC in biodiversity monitoring in the Tanami Desert. There is further potential for such support, perhaps including market-based approaches, through corporate social responsibility programs of mining companies. There is also demand from mining companies for Aboriginal land management services for tasks ranging from cultural clearances of exploration areas to weed control at mine sites and rehabilitation.

Their EOIs would be developed on the basis of their established relationships with landowner groups in areas where they propose to undertake contracted works and their understandings of what they could achieve in conjunction with those landowners. These organisations are not structured to employ landowners directly. Hence they would either pay a relatively small fee to the landowners involved based on their contributions in time and expertise to the contracted works, or make an agreement with CDEP organisations to employ individual landowners to undertake the contracted works since. An EOI call might also attract attention directly from some CDEP organisations, Aboriginal tourism or pastoral enterprises, resource agencies, community councils or other Aboriginal service organisations.

Overall, however, there are real limitations on likely market depth. An EOI call across the spinifex desert region could be expected to attract about 10 responses. Some of the likely respondents, such as APY, CLC and Ngaanyatjarra Council, could potentially offer multiple EOIs on behalf of different landowner groups in their large areas of operation. However their own capacity to generate these, including negotiating them with the relevant landowner groups, is quite constrained. There is also a risk that over-reliance on LMUs will progressively shift responsibility for biodiversity and other aspects of land condition from landowners to these service organisations without significantly building landowner capacity.

This case study can only very speculatively address the question of how Aboriginal landholders would respond to the competition that is inherent in market-based approaches to biodiversity conservation. In spite of the poorly developed market economy in the spinifex deserts, competition – for limited NRM grant funding or through tenders for delivering community services – is already pervasive. However it is Aboriginal organisations and their staff, rather than landowners themselves, who are involved in these processes. If engagement in market-based approaches to biodiversity conservation is solely through LMUs, the difference to existing grant-funded approaches is likely not to be apparent to landowners themselves.

Nevertheless competition is well established in some aspects of landowner activities. Through the art market at least, many Aboriginal people of the region are well aware of the difference in value between the work of different producers. They also routinely behave competitively in relation to non-monetary rewards, ranging from football games to recognition by others that they have carried out their customary or other responsibilities properly. These factors indicate that the competition inherent in market-based approaches is unlikely to be a barrier to their adoption per se. A more significant factor will be maintaining commitment to ongoing achievement, since Aboriginal people who are successful in competition often attract increased ‘humbugging’ – jealousy from others and demands for sharing rewards – that can weaken motivations to continue to compete.

6. Integrated approaches to enhancing biodiversity benefits

There is an opportunity to foster an economy around biodiversity conservation in this region, but change processes will need to operate on a generational time scale to have a significant impact on the prevalent depressed socio-economic characteristics. This section outlines some key structural and process considerations for developing a more open marketplace for biodiversity in conjunction with other change processes.

6.1 Incentives

It is risky to rely on money as an incentive for biodiversity benefits in this region. The value of money is distorted by irregular and uncertain incomes as discussed in Section 2.2. Money is invested in maintaining social relations and wide kinship networks, through gifts and gambling, making it difficult to envisage how there will ever be 'satiation', or that relatively subtle market signals will be perceived. Further risks arise from landowners' well-developed capacity to use available resources for immediate need and advantage coupled with poorly developed understanding of contract accountabilities.

Incentives for landowners to produce biodiversity benefits need to align financial incentives with deeper motivational factors. For example, commercial bush harvest of plant foods engages harvesters willingly because financial incentives align with other incentives which have strong appeal to landowners. These are related to expression of cultural identity, pride and confidence from use of customary skills and knowledge, recognition of the value of the activity to 'outsiders', enhanced networks and confidence in interactions with 'outsiders'. These same motivational factors help to account for Aboriginal engagement in two other initiatives described in Appendices to this report – Indigenous Protected Areas, and Waltja's *Training Nintiringtjaku* network. They feature strongly among the deep motivations that landowners in this region have to undertake activities on country (see Table 3). Such factors build the capacity of landowners for mentoring young people for cross-cultural success. The importance of this to landowners is indicated by the strong emphasis on opportunities for youth in Shared Responsibility Agreements negotiated in this region, as highlighted by the analysis in Appendix 4.

6.2 A market chain approach

In the spinifex deserts market signals about biodiversity conservation will very rarely be detected by Aboriginal landowners unless they are communicated by mid-level actors such as land councils, LMUs, non-government conservation organisations, Aboriginal service delivery organisations, individual brokers and enterprises operating in the NRM sector. As discussed in Section 3.2, individuals and the staff of organisations in this mid-level space are interpretive mechanisms or 'translators' between government and Aboriginal landowners. Effective mid-level actors can engage with both groups, understand their motivations and incentive structures and contract and maintain accountabilities with both.

Well-established examples of this critical mid-level role for Aboriginal market engagement in spinifex deserts are the role of wholesalers in the commercial bush harvest of plant foods (see Appendix 1 and Walsh et al 2006), and of community art centres in the Aboriginal arts industry (see Wright & Morphy 2000). In the case of bush harvest, harvesters get their market signals through the actions of wholesalers. Wholesalers get market signals directly from their produce sales and their own market research. They understand enough about the resource and harvester activities to design supply systems and price incentives that meet market demand. In contrast, retailers and consumers tend to know very little about how the market signals they generate by selling and buying products containing bush harvested ingredients (or not doing so) actually impact on harvester behaviour.

Extending this supply and demand chain analogy to biodiversity conservation, we can see that governments are in the same position as retailers and consumers of bush foods. They can not know how incentives they might put in place for biodiversity conservation are actually impacting on landowners' actions and behaviours except in the very rare cases where they have a significant direct field presence (for example, the SA government's involvement at Watarru in the APY lands).

Mid-level actors have an analogous role in biodiversity conservation to that of wholesalers in the bush food industry. Their relationships and communication with landowners are critical factors in translating incentives offered by government and other potential purchasers of biodiversity benefits into changed actions and behaviours by landowners. They also have their own incentive structures that need to be taken into account in designing MBIs for biodiversity conservation. These variously relate to factors such as income and other livelihood issues for principals/staff, staff retention, statutory functions and other accountabilities to their constituent and client groups.

A well-developed biodiversity market chain for the spinifex desert region would have several market components.

- **Purchasers** of biodiversity outcomes, such as governments and industry entering into contracts for services
- **Brokers** who understand purchaser requirements for biodiversity conservation and also the assets, capabilities and motivations of landowner collectives and who have clear incentives to make an effective match. At least two different broker roles will be necessary for market efficiency:
    1. brokers who link between landowner collectives and potential investors in biodiversity benefits and other compatible products/outcomes. These brokers would add value by 'bulking up' investments from various sources to achieve a critical mass of contractible services in one place/region. Provision of tourism/outdoor recreation/education opportunities is one obvious market. Carbon sequestration through land rehabilitation or fire management may also have potential, subject to improved scientific understanding of its relationship to biodiversity conservation.
    2. brokers who link between landowner collectives and individual/family landowners. They would add value by facilitating design of locally specific incentives and social controls. This is a broker role that offers particular opportunities for landowners themselves, drawing lessons from the Waltja *Training Nintiringtjaku* initiative (see Appendix 2).
- **Landowner collectives** with capacity to deliver to contract specifications (either directly or by sub-contracting to other enterprises or individuals). Contracting capacity includes:
    - strong planning and governance systems
    - workforce and resource management systems that can accommodate mobility of individual workers
    - an understanding of the assets, capabilities and motivations of individual landowners and family groups whose involvement or approval will be needed for delivery to contract.
- **Individual landowners and family groups** whose behaviours and actions are regulated by effective social controls in place within the collective they belong to, such that these support the biodiversity contract outcomes being pursued by the collective, or at least do not detract from those contract outcomes.

At present, there are significant capacity limitations throughout this system and particularly in contracting capacity. LMUs are the main mid-level organisational actors. Their present role has elements of broker and landowner collective and they typically struggle to play both roles effectively.

Increasing capacity for landowner collectives to employ landowners for biodiversity works is an important starting point in enhancing contracting capacity. Contracts to corporate landowner collectives for biodiversity conservation services will provide jobs, particularly for young people in 'ranger work', and valued mentor/cultural adviser roles for older traditional owners. This will promote capacity for Aboriginal people of spinifex deserts to engage with markets in three ways:

1. by providing individual landowners with work experience, which is particularly important for young people. A work history is one of the significant factors that has enabled the current generation of Aboriginal enterprise owners/operators to be successful in business in remote and regional Australia (DEWR 2005, Moylan in prep)
2. by building capacity for landowner collectives to contract for NRM services to meet any industry demand in their region – such as at mine sites, transport and utility installations, pastoral stations –and for landowners to be employed in these contracts
3. by building capacity for development of small-scale Aboriginal natural resource management enterprises with biodiversity outcomes, such as proposed pet meat harvesting of camels in the APY lands (AWS 2005), which can employ landowners (see Desmond & Rowland 2000).

It is notable that leading 'top end' NT community ranger groups and associated family/clan–based enterprises are effectively developing these market opportunities now, 10–15 years after these ranger groups' formative periods. This indicates that it will take at least a decade for spinifex desert groups to develop strong capacity for market engagement through enterprise even without accounting for differences in social and ecological characteristics between desert and tropical environments.

However, an approach centred on employment/'ranger' jobs is unlikely to realise the full benefits of a market approach, either in terms of cost effectiveness for purchasers or the flexibility for landholders to integrate provision of biodiversity services with other aspects of their lifestyle. Being realistic about the job/employment paradigms suited to remote economies and lifestyles, there is a need to move to a system in which individuals and family groups are paid on a contract basis for specific services. This should be achievable given sufficient long-term support. But it will depend on:

- standards and metrics for specific outcomes in relation to issues/threats such as environmental monitoring, reduced feral animal populations, reduced spread of weeds, or fire regimes in priority localities
- mid-level organisations with capacity to effectively support landowner micro-enterprises to access equipment and training and to manage their finances, responsibilities, and entitlements in relation to tax and social security
- effective cross-cultural communication about standards and metrics and accountabilities.

Again, the experience of the commercial bush harvest of plant foods is instructive. In this production system:

- metrics are very clear: wholesalers pay harvesters per kg for plants harvested to their specifications, including cleaning and pre-processing

- demand is communicated directly by face-to-face dealings between wholesaler and harvester
- harvesters have maximum flexibility to fit their harvesting activities with other aspects of their lifestyle, including harvesting for their own consumption and teaching children about country
- customary property rights are addressed in harvesting (through harvesters negotiating directly with other people in their landowning collective about access to country for harvesting)
- the 'money story' is consistent: wholesalers pay cash or cheque on the spot for their purchases, minimising inconsistencies, misunderstandings, delays and consequent frustrations between wholesalers and harvesters about financial transactions.

These characteristics of commercial bush harvest indicate benchmarks for design of effective markets for spinifex desert Aboriginal landowners to produce biodiversity benefits.

6.3 Integrated investment for integrated outcomes

Contracting for biodiversity benefits offers a key opportunity to support the development of an economy in spinifex deserts in which landowners realise benefit from their extensive landholdings in proportion to effort rather than only seeking 'rent' or 'royalty' for use of the resources from those lands by others. Such a nexus between effort and benefit is an underpinning for effective governance of common property resources such as are represented by the Aboriginal lands of the spinifex region (Ostrom 1990, Anderies et al 2004, Ostrom 2005). It has also been highlighted by Noel Pearson in his critiques of the impact of 'passive welfare' on motivation among Aboriginal Australians (Pearson 2000a, 2000b, 2001).

Biodiversity services offer one of very few potentially commercial land uses that can address current welfare dependency of Aboriginal landowners. They also offer the strongest option for maintaining transmission of traditional ecological knowledge. Outcomes from well-designed action to achieve biodiversity benefits also holds promise for considerable benefit to landowners' psycho-spiritual and physical health and wellbeing. Project workshop participants noted that such outcomes are widely reported by landowners who are engaged in looking after country in the spinifex deserts through customary practices and/or formal NRM activities and by service providers (and see Burgess et al 2005 and Appendix 1). However it must be recognised that not all outcomes are necessarily positive. Further, planning for integrated investment needs to recognise that outcomes for Aboriginal health and wellbeing depend on big changes in landowners' exercise regimes, diet and family financial management. These will not be achieved only through landowners engaging in the work involved in delivering to biodiversity services contracts.

Regional Partnership Agreements (RPAs) and Shared Responsibility Agreements (SRAs) provide a vehicle for investment by several sectors of government for outcomes that could include biodiversity benefits as well as positive social and economic outcomes. Appendix 4 outlines some of their characteristics and issues they address. While early development of SRAs paid little attention to land management issues, some SRAs and RPAs are now being developed around natural and cultural resource management themes in spinifex deserts as a mechanism for landowners to look after country better and improve their health and wellbeing. These include an RPA on 'caring for country' in the APY lands, an SRA on land and cultural heritage themes in the Ngaanyatjarra lands, and the Land and Sea Management Schedule of the *Overarching Agreement* *on Indigenous Affairs between the Commonwealth of Australia and the Northern Territory 2005–2010*. The APY lands RPA development process envisages integrated investment for outcomes related to natural resource condition and associated employment, health and wellbeing, reflecting landowners' integrated view of these issues. SADEH's partnership with Watarru community (and IPA) in the APY lands is already giving some attention to monitoring these integrated outcomes (SADEH 2005a).

Assessing outcomes from integrated investment presents its own methodological challenges, notwithstanding the significant foundation provided for assessing social and economic outcomes by the *Overcoming Indigenous Disadvantage* reporting framework (SCRCSP 2005). The only clear overlap between this framework and the *National objectives and targets for biodiversity conservation (2001–2005)* (EA 2001) relates to maintenance of Indigenous ethnobiological knowledge. However, knowledge maintenance cannot really be achieved out of context of the health and wellbeing of the knowledge holders. Landowner capacity to contribute to addressing biodiversity threats is also fundamentally related to their health and wellbeing. Arguably, this integral relationship between knowledge, capacity, and the health and wellbeing of landowners needs to be better recognised in national and regional planning for biodiversity conservation. Equally, the importance to Aboriginal health and wellbeing of sustaining Aboriginal landowners' active engagement with their lands in the spinifex desert needs to be more overtly recognised in approaches to Aboriginal development in the region.

A social enterprise model that values outcomes for health and wellbeing as well as biodiversity outcomes is appropriate to developing capacity among landowner collectives for enhanced biodiversity benefits in the spinifex deserts. 'Social enterprises' are organisations which trade in goods or services and link that trade to a social mission. While the term is used for a diverse array of entities in various countries, social enterprises are generally held to comprise the more businesslike end of the spectrum of non-government organisations, with at least half their income derived from trading rather than from subsidy or donations.[13]

The social enterprise model is appropriate for developing biodiversity benefits markets in spinifex deserts because of the array of interdependent human capital and social issues which now limit Aboriginal landowners' capacity for market engagement. Social enterprise development for biodiversity conservation could be pursued by matching investment from social sectors of government and philanthropic organisations in enterprise establishment, physical asset management, human resources development and governance, with a program to develop contracts in environmental monitoring and biodiversity asset management. The latter will require investment in the costs for the critical enablers of capacity for formal NRM activities such as brokers and planning (see Section 3.3.2). Data collection needs considerable start up investment in design and communication of metrics and techniques that have scientific validity and are accessible to landowners of the region.

Institutional change to establishing a nexus between effort and benefit in the social systems of spinifex desert Aboriginal landowners is a big challenge. As Martin (2001) comments, this will not be achieved just by persuasion and negotiation. Investment from governments in contracting for biodiversity services has potential to play a role if this investment is part of development of an adaptive, learning system (see Folke et al 2003, Anderies et al 2004). This will require that:

- investors are clear about the outcomes they want for key components of the social-ecological system

13 See Wikipedia entry, 'social enterprises' and links to European, Canadian and US practice. http://en.wikipedia.org/wiki/Social_enterprise

- ‘rules’ – standards and quality assurance procedures – are clear and well targeted to desired outcomes
- landowners get regular feedback on performance with a graduated system of rewards and sanctions linked to performance and conflict resolution procedures
- networks among landowners provide for them to learn from each others’ experience as well as from their own, and adapt their behaviour accordingly
- investors systematically adapt ‘rules’ on the basis of experience of how effectively the system is achieving desired outcomes.

7. Recommendations

Creating a more open biodiversity incentives marketplace in the spinifex deserts requires concerted attention to building Aboriginal landholders’ capacity for market engagement, identifying specific biodiversity outcomes that potential purchasers of biodiversity benefits seek in the region, and developing standards for services provided by landowners to address those outcomes. Recommendations for creating a more open biodiversity marketplace in this region are that:

- support establishment of landowner collectives with contracting capacity – effective ‘social enterprises’ which employ landowners, particularly youth, in ‘ranger’ roles and provide valued mentoring roles for elders
- seek opportunities to implement micro-enterprise approaches in which individual landowners and family groups are paid on a contract basis for specific biodiversity services with flexibility in how they integrate provision of these with other aspects of their lifestyle
- aim to develop all elements of the market chain, recognising the key role of mid-level organisations and individuals as brokers for biodiversity and other compatible services (such as eco-tourism, sustainable grazing, carbon sequestration, and land condition and water resource monitoring) as part of a ‘conservation economy’
- invest in capacity building through social sectors of government in recognition of the health and wellbeing outcomes that can be anticipated from well-designed programs that engage landowners more actively in management of their land
- invest in specifying priority biodiversity outcomes for the region, in parallel with a concerted program to build landowners’ awareness about what other people value about the biodiversity on their lands and why
- direct investment to biodiversity outcomes that appeal to strong landowner motivations such as pride in productive country, knowledge and skills, as well as income generation
- invest in developing metrics for biodiversity benefits through fire management
- invest in developing measurement protocols that engage landowners’ skills and know-how and provide scientifically robust measurement as a basis for contracting services in environmental survey and monitoring, ground-truthing of remotely sensed data and models, and for measuring other contract outcomes
- foster networks among landowners involved in these activities and promote an adaptive learning system that embeds quality assurance and feedback on performance.

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Appendix 1: Aboriginal activities on country

Aboriginal people undertake a wide variety of 'activities on country' in the spinifex deserts. These are activities that result in people getting out of larger settlements and spending time on the surrounding lands and at outstations/homelands. A number of activities with economic, social or cultural purposes are typically undertaken on visits to country:

> *One activity provides the reason for going out on country but people do lots of other things. When we went out to look at a rockhole, the ladies were collecting seed and getting bark for ash for pituri and the men were getting wood for carving.*
>
> Project interview, Aboriginal NRM facilitator

Here we describe some characteristics of activities that have direct economic links: customary production of food, formal NRM activities, and market production from natural resources. Customary production of food is a residual, though still culturally significant, activity of the customary economy. Formal NRM activities are a new economic activity. Formal NRM activities and market production from natural resources, notably in commercial bush harvest of plant foods (Box 3), draw on the skill sets and property rights of customary food production. The role of Indigenous Protected Areas in Aboriginal activities on country is also discussed below. These provide a management framework for several landowning groups in the region.

Customary production of food

Customary production of food (and also bush medicines) is relevant to incentives for biodiversity conservation because:

- it continues to use traditional skills and engage traditional land management practices; the contemporary biodiversity values of the spinifex deserts are a legacy of such practices
- it provides direct private benefit to Aboriginal landowners and strong motivation for activities on country, which can usefully inform design of effective incentives
- it impacts on biodiversity resources where there are localised resource depletions
- threats to customary food resources are readily appreciated by Aboriginal people of the region, providing a strong point of engagement for planning and action on biodiversity conservation.

There is relatively little data on the extent of subsistence production in the region, or elsewhere in desert Australia, even compared with more northern parts of Australia (but see Cane & Stanley 1985, Devitt 1988, Walsh 1990, Palmer and Brady 1991, Walsh 1992, Bird et al 2004, 2005). In most of the region the proportion of Aboriginal people who said they engaged in hunting and gathering was 10–20% in 1994, with a higher proportion in the southern NT (NATSISS 1994 in Arthur & Morphy 2005[14]). However, it is not possible to draw conclusions from these data about how much subsistence production occurs, or about trends.

Landholders widely report that access to customary foods is important to their spiritual health. Biomedical research has shown that physical health benefits of traditional diets and diet structures, compared with typical carbohydrate rich diets of Aboriginal people dependent on remote stores for food (O'Dea 1984; Naughton et al 1986; O'Dea et al 1988, Wortman 2006). McDermott et al

14 The 2002 NATSISS survey used different questions about subsistence production from those used in the 1994 NATSISS survey as discussed by Altman et al (2006). The 2002 survey found that 82.4% of the 2120 people sampled from discrete communities and outstations in Queensland, SA, WA and the NT (including tropical regions) said they had fished or hunted in a group in the past three months. The 1994 survey question was framed in terms of 'recreational' hunting, which may have generated under-reporting of subsistence production in remote communities because hunting is not seen as 'recreation' by respondents.

(1998) found that people living on dispersed outstations in central Australia are physically healthier than those living in large settlements, with one reason being easier access to a more varied and nutritious diet through customary food production (and see McLaughlin 2006).

It appears that most desert Aboriginal people now source much less food from hunting and gathering than in the tropical north of Australia; this is fundamentally due to harvesting being more costly and risky in the variable and relatively low productivity desert environments. Nevertheless, there are some situations where the proportion of food from local bush harvest is high. Bird et al (2005) found that 25–50 per cent of the total diet of 100 Martu people at Parngurr in the Great Sandy Desert of WA comes from foraging, and on the 3–4 days that they forage that figure is 80 per cent. Devitt (1988) found at Utopia in desert Australia that 31% of energy intake and 74% of protein came from bush foods, which is broadly comparable with Altman's (1987) findings from Momega outstation in tropical Arnhem Land that bush foods provided 46% of energy intake and 81% of protein.

The high levels of customary food production noted above are almost certainly atypical in deserts. The cost of customary production is high in the spinifex desert region because resource distribution is relatively sparse. Nevertheless, customary production is a prime aim and motivator for land use among older Aboriginal people across much of the region. A clear indication of its significance is given by Walsh's (2000) analysis of land use issues and aims raised by the 199 landowners who participated in Central Land Council (CLC) land use planning workshops between 1996 and 1999. Issues and aims grouped as 'collect, hunt and manage bush foods and medicines' were the most commonly raised overall and were particularly prominent among issues/aims raised by women.

Poverty underlies the typical reasons why the region's landowners say they do not spend more time in customary food production: 'no motor car, no petrol, no gun'. People typically undertake some customary production of food and other items as part of visits to country for other reasons, such as formal NRM activities.

Resource depletions around settlements contribute to the cost of accessing harvestable resources. The risk of resource depletion is noted by Cane and Stanley (1985) and Walsh (1992) while Walsh (2000:17) notes, on the basis of CLC's land use planning with landholders in the late 1990s, 'plenty of anecdotal evidence that certain species have declined – for example emu, red kangaroo, echidna, perentie and other larger species' and notes that hunting pressure is implicated as one cause of decline.

The management plan for the Ngaanyatjarra Lands IPA (Noble 2002, and see Noble 2004) identifies 'intensive resource use zones' of 50 km radius around eight major settlements in or adjacent to the IPA, which are the places where the large majority of landowners live. These zones were identified as a result of Ngaanyatjarra people's interest in sustainability of resource use, and observations that use is more intensive around settlements. The 50 km radius identified in Ngaanyatjarra Council's planning is arbitrary, not based on any study, but signalling an intention to investigate how to effectively manage for the issue of resource depletion around settlements.

'Kuka Kanyini – looking after game meat animals' emerged as a theme in the Anangu Pitjantjatjara Yankunytjatjara (APY) lands from concerns expressed over several years by Aboriginal landowners about resource depletion due to species extinctions and declining populations of species that are common elsewhere such as red kangaroo and emu (Robinson et al 2003, Breckwoldt et al 1996). 'Kuka kanyini' provides a central theme for the draft Regional Wildlife Management Strategy for the APY lands (APYLM & AWS 2003; AWS 2004, 2005) and for the collaborative wildlife management project being undertaken by SA Department for Environment and Heritage and Watarru community (SADEH n.d., 2005a, 2005b, McFarlane 2005). Strategies to address depletion of valued resources in these cases involve a broader community development approach and include:

- intensive management of habitats in core areas
- establishment of awareness, education and commitment to action such as through social controls on harvesting
- monitoring
- addressing factors that limit landowners' access to alternate harvesting areas, such as driver training and access to vehicles.

Formal NRM activities

'Formal NRM activities' are defined for the purposes of this case study as activities related to natural resources and their use that are undertaken by Aboriginal landowners, landowning organisations or other entities with designated external funding support.

These activities are relevant to design of incentives for biodiversity conservation because they are the mechanisms through which government agencies, NGOs and researchers most often engage with Aboriginal landowners about biodiversity resources, threats and actions to address threats. They highlight:

- the limited institutional capacity within the spinifex deserts for biodiversity conservation
- innovation and positive outcomes in a number of examples
- the key role of the structures through which formal NRM activities are planned and undertaken, notably land management units (LMUs) of land councils/landowning bodies and community ranger groups, as agents or brokers in contracts directed at biodiversity benefits.

Funding sources

Formal NRM activities are typically funded through the Natural Heritage Trust (NHT) via grants to landowning organisations or projects administered by other parties. They tend to focus on management actions identified as priorities in NRM regional plans and investment strategies or other NHT programs, reflecting this strong reliance on NHT funding. At least some of these strategies do now reflect threats to country that Aboriginal landowners are concerned about (as discussed in Section 2.4).

Formal NRM activities often access CDEP (Community Development Employment Project) funding as a mechanism for subsidising wages. CDEP is a long standing program with a long history. Many Aboriginal people in the spinifex region have negative attitudes towards it (see Box 2, below). Taylor (2003a) points out that land restoration and management is one of a suite of activities that contribute economically to remote communities through import substitution and whose diversity and value is rarely recognised because they are seen amorphously as 'just' CDEP work.

The accessibility of NHT funding varies markedly between states/NRM regions. APY Land Management Unit has had significant investment in its planning and on-ground works through the SA Alinytjara Wilurara NRM Board from 2004 and predecessor institutions. CLC is having reasonable success in accessing NHT grant funding through the NT NRM Board. Ngaanyatjarra Council has had no success in accessing funding through NHT NRM regional allocations in the WA Rangelands NRM region.

Other funding sources for formal NRM activities include research grants and state government investments in joint managed protected areas and in biological survey and monitoring. At Watarru in the APY lands, SADEH funds the employment of 11 Aboriginal landowners full time, and a further 10 casually, for work directed at biodiversity conservation outcomes (SADEH 2005b). It has also invested in detailed planning for survey and monitoring of populations of particular species and threat abatement (McFarlane 2005). In the Ngaanyatjarra lands, a Strong Families project focused on providing education for NRM in a family cultural and environmental context was funded through Lotteries West. CLC accesses some project funding for formal NRM activities from the Aborigines Benefit Account established by the *Aboriginal Land Rights (Northern Territory) Act* 1976, as well as the statutory allocation from this account that funds its core operations. Some NT Aboriginal landowners commit a proportion of funds due to them from this source as a result of mining activities on their land to support their activities on country. All park management agencies in the region contribute to funding Aboriginal activities on country in and in relation to protected areas through their joint management initiatives.

Health, social service and education agencies are also involved in funding and undertaking activities that would fall within our definition of 'formal NRM activities' such as:

- taking people out on country for mental health reasons
- recording and transmission of traditional knowledge (e.g. as part of Jara Pidjidi 'youth at risk' project at Mt Allen outstation)
- school camps and cultural education programs
- formal land management curricula in the University of South Australia's AnTEP teacher education program in the APY lands and in Vocational Education and Training (VET) conservation and land management courses
- revegetation and landscaping for dust mitigation in settlements.

Resourcing of land management units

LMUs are a key actor in the majority of formal NRM activities that occur in their geographic areas of operation. Staffing levels in LMUs vary over time as salaries are often paid through project grants or other short-term funding sources. Ngaanyatjarra Council and APY, two major landowning bodies in the spinifex deserts, each have land management units with 3–5 staff. CLC, which has statutory roles to represent and protect the interest of NT Aboriginal landowners, has 6–10 staff working on various projects in the spinifex deserts, some of whom are funded from its core budget.

Coordinator positions may have more secure funding from employing organisations' core budgets or partnership arrangements with other agencies. CLC and APY LMU also auspice NHT-funded Indigenous Land Management Facilitators. All LMUs recruit scientifically trained staff as well as providing for employment of Aboriginal landowners as project funding allows. The NT government has partnered with CLC in several initiatives in capacity building for NRM and tourism enterprise development. The Indigenous Land Corporation (ILC) is also a partner in one of these initiatives – the NT Indigenous Pastoral Program, which is a joint initiative with NT Government (via DPIFM), NLC and CLC. ILC has co-funded the Ngaanyatjarra Lands' coordinator position with Shire of Ngaanyatjarraku and supported the development of significant planning frameworks for the development of the LMU and the delivery of NRM services by Ngaanyatjarra practitioners.

LMUs experience pressure from landowners to operate equitably across the whole area of their jurisdiction, but accountabilities for project funding limit where they must put effort. For example, the Ngaanyatjarra IPA does not extend to native title lands, but landowners see the same tasks involved in management of these lands as within the boundaries of the IPA. Ngaanyatjarra Council is looking to develop SRAs to support NRM across all the Ngaanyatjarra Lands, extending beyond the current IPA.

Engagement with landowners

Aboriginal landowners engage with formal NRM activities as individuals or small family groups. Their regular income is typically from part-time work through CDEP or from Centrelink benefits. The mechanics of engaging people for casual work in formal NRM activities are not straightforward because recruitment and payment has to take account of CDEP and Centrelink rules as discussed in Box 2, below.

We estimate that less than 30 Aboriginal landowners in the spinifex deserts are engaged in formal NRM activities on their own lands full time or in a regular part-time paid capacity. Up to 1,000 landowners are estimated to have been engaged casually in recent years in formal NRM activities, if children involved in school-based or family wellbeing visits to country are included. Most people are involved for only a few days over a year and any income paid for work undertaken makes a relatively small economic contribution.

Box 2: CDEP and Centrelink issues for land management employment

CDEP enables many formal NRM activities to take place. For NHT-grant funded projects, the grant provides a 'top up' to the two days of wages typically paid by CDEP schemes to their participants. These two days provide the grant-recipient contribution to project costs that is required for NHT funded projects. CDEP provides an administrative structure that facilitates casual employment by handling payroll, workers compensation and similar employment requirements.

Participants in the project workshop identified that use of CDEP in formal NRM projects is problematic in several ways. CDEP is widely considered by Aboriginal people to be 'not real work' because it is work for the dole. It is not seen as 'a fair day's pay for a fair day's work'. This can impact on Aboriginal people's attitude to the work, and on pride in their work. Psychologically it can inhibit development of a 'work ethic'. Use of CDEP is seen as particularly undervaluing Aboriginal landowners' contributions in cases where projects involve landowners sharing ethnobiological knowledge with scientists or government agencies for the broader public good.

The calibre and character of the CDEP coordinator has a strong influence on whether CDEP can be used effectively in land management, as do the CDEP guidelines. Under current guidelines CDEP participants may work in activities that meet community needs, including those identified in SRAs or community plans, as well as work that builds skills and is aligned with local job opportunities (Australian Government 2006). There is high competition for CDEP labour because of reliance on it for municipal services or other settlement tasks. LMUs need to negotiate for CDEP-paid hours for land management projects. If no CDEP hours are available, full wages have to be paid from land management grants in order to undertake the project, even though budgets may not provide for this.

There are also problems associated with casual employment of people whose main income is through Centrelink benefits, due to the administrative mechanisms for Centrelink payments. Extra income has to be declared and pensioners risk losing the pension if they earn extra income, at least beyond occasional one-off payments. It is a complex area for Centrelink recipients to manage. In addition, it can be difficult for land management units to find practical ways to transfer money to casual employees who are on Centrelink benefits, because they tend not to have any administrative support or payroll systems established.

Older people may be engaged as project consultants or advisers in roles that draw on their specialised skills and knowledge of an area or on their cultural authority. This is a way that some Aboriginal people realise a market value for their knowledge. Aboriginal organisations and other commentators advance cogent arguments for the pay rates for these roles in externally funded and managed projects to be on par with those for people with specialised skills and knowledge in scientific domains of NRM management. However, project leaders commonly point out that they cannot afford to pay these high rates and/or have difficulty justifying this cost in terms of project outputs.

Younger people are usually engaged casually as project workers. LMUs are active in fostering training opportunities, especially for younger people. Training is provided by VET providers. In the spinifex deserts Ngaanyatjarra College and Batchelor Institute for Indigenous Tertiary Education are significant providers through field workshops addressing national competencies for Conservation and Land Management.

Community ranger groups

Many places in the NT have developed community ranger groups to provide a structure for Aboriginal landowners to work in formal NRM activities. Community ranger groups particularly engage younger people. They also typically provide for cultural authority and supervision of project work, linkages with CDEP and training, and contract their work force to other landowners and organisations for NRM and related work. Community ranger groups are best developed in the top end of the NT (see Davies et al 1999, Altman and Cochrane 2003, Altman and Whitehead 2003, Cochrane 2005, Johnson et al 2006) where some are leading innovators in sustainable commercial use of wildlife and in engaging with market demand for carbon sequestration (Horstman 2006). Ranger groups are far less developed in the spinifex deserts. Part of the reason is undoubtedly the very different characteristics of the desert biophysical environment, social structures and economy.

There are about 10 nascent or developing community ranger groups in the NT parts of the spinifex deserts. There is also one group in the southern Great Victoria Desert in SA, managed through Maralinga Tjarutja and Oak Valley Inc. In total, about 100 Aboriginal people regularly participate in work and training through the NT spinifex desert community ranger groups and associated formal NRM activities. Although some groups only involve men, some have very active involvement and leadership by women, and at least one only involves women. The groups are nascent since employment opportunities depend on project funding or work contracts being available. Some participants are involved in ongoing training independent of the availability of paid work. Engagement with training providers (e.g. through Batchelor Institute of Indigenous Tertiary Education for groups in NT parts of the spinifex desert region) is fostering some ranger groups' ongoing identity even though demand for them to work in NRM projects is discontinuous.

A good skills base for community ranger work exists in most communities with the prevailing cultural context providing young people with a range of bush skills and good spatial understanding of their land. The value of structured community ranger groups lies in their ability to harness these abilities and afford ongoing capacity for formal NRM activities, notwithstanding discontinuities in the availability or engagement of individual participants. The group approach works well because it allows individuals to complement each other's skills. Where a structured group exists many individuals may drop in and out of work as their circumstances or skills permit, but the structure still provides a group workforce. This means that individuals' mobility is not a significant problem for achieving NRM outcomes, except where particular individuals are involved in formal training and the group is required to show training outcomes.

There is strong interest from Aboriginal landowners and CLC in expanding this community ranger movement, in establishing groups on a sound business footing, and in using land management work as part of broader strategies for community development and diversion from substance abuse. There is interest in the NT government in contracting ranger groups for maintenance works in joint managed parks. This follows on from an introductory Flexible Employment Program run by the NT government that engaged 140 Aboriginal people in casual work in park management in 2004/05 to build relationships and mutual understanding about working in protected area management.

Outstation resource agencies (which typically operate CDEP programs) are a natural vehicle for fostering the development of community ranger groups as enterprises. This is because although they are typically based in larger settlements their work is on surrounding lands and their governance structures represent landowners from the outstations they service. Their dependence on CDEP and other government programs for operational resources makes them vulnerable if changes in government policy do not match their own agendas.

APY and Ngaanyantjarra Council LMUs are not actively pursuing the development of formalised community ranger groups. They engage and employ landowners in formal NRM activities on a project-by-project basis, and these people are sometimes referred to as 'rangers'. They are seeking to expand and bring more continuity to Aboriginal landowner employment and develop small-scale NRM enterprises including family/clan–owned and –operated enterprises (Noble 2004, AWS 2005).

Measuring change

All LMUs are engaged in some monitoring of biodiversity resources in their areas of operation through activities such as survey for threatened species, assessment and monitoring of threats, mapping fires, and monitoring quality and threats to natural water sources. The activities have tended to be sporadic and ad hoc reflecting discontinuous funding and lack of investment in developing monitoring protocols and techniques. However, LMUs aspire to do better and are working to develop capacity in this area.

CLC has developed a biodiversity monitoring program for the Tanami region in partnership with Newmont Mining and in consultation with representatives from conservation groups, NT government and private environmental consultants. The program has established mechanisms to monitor a systematic sample of approximately 100 sites over an initial five-year period. It aims to establish the distribution and abundance of selected wildlife species in the vicinity of the Tanami mines and establish a biological and landscape database to support assessment of the impact of current and future mining operations, including cumulative impacts. The first census period in 2005 generated 108 days' work for community rangers and other Aboriginal landowners, a demand that is expected to be repeated twice yearly. Methods for wildlife survey and monitoring make extensive use of Aboriginal tracking skills (Stoll et al 2005; Nic Gambold CLC pers. comm.).

Indigenous Protected Areas

Indigenous Protected Areas (IPAs) are relevant to the development of incentives for biodiversity conservation because:

- IPAs are the outcome of decisions by Aboriginal landowners in the spinifex deserts to manage their country sustainably with biodiversity conservation as an explicit or implicit part of the mix of objectives
- AGDEH engages closely with four Aboriginal landowner organisations in the spinifex deserts in the management of the IPA program
- the IPA program is driven by incentives, landowner motivation and contracts for specified outputs
- experience with the IPA program indicates some of the constraints on moving from assessment of outputs to outcomes but also the importance of doing this if the IPA 'brand' is to achieve investor confidence.

IPAs are a funding program, part of NHT administered through AGDEH. But they represent much more because their voluntary declaration by Aboriginal landowning organisations has involved wide consultations with members of the landowning group and an overt decision to look after the country within the IPA. IPAs also increasingly represent a 'brand' that Aboriginal landowners are using to attract investment from various sources (see Box 1).

Management plans for IPAs in the spinifex deserts each provide for a wide range of objectives and expected outcomes. Biodiversity conservation is either explicitly included or is implicit in these objectives. Typically the objectives reflected in the plans that IPA landowners and LMUs have produced are: maintenance and transmission of traditional knowledge; continuation of traditional practices; customary food and medicine production; survey and monitoring of biological resources and threats; addressing threats to particular species; patch burning; protection and rehabilitation of natural water sources/wetlands; and development of employment and small-scale enterprises such as in tourism and mustering feral animals for sale. The Paraku plan also aims to develop a sustainable regime for cattle grazing. Social objectives are prominent in all IPA plans. They include training and employment, and, in some cases, improved health of landowners through exercise and better diets anticipated from the focus on working on country.

IPA program

Involvement with the IPA program is initiated by Aboriginal groups and the drivers are cultural and economic; typically landowners want to look after their country and develop options and opportunities for young people and to get support for that aim. The IPA program will fund landowner organisations to produce a management plan and decide if they want to manage country as an IPA. This can be a lengthy process – it took five years in the case of the Ngaanyatjarra IPA. It needs to involve extensive consultation among landowners, developing their awareness of the concept and its potential; and examine land use issues and options and assess their compatibility with management of the area as an IPA. There is no pattern to the constitution of the body that the IPA program contracts with. Some are family-based corporations, others are statutory landowning bodies, or land councils representing landowners. It depends on where the initiative comes from and which actors have authority for land management and capability to contract.

To date, all groups who have developed management plans have declared their areas as IPAs. Management Plans provide the interpretive framework between the landowners' values and other values for biodiversity. The plans and the IPA program in general work to landowners' own goals rather than imposing other value systems such as biodiversity conservation. The management scheme set out in the plan is compared with the IUCN (World Conservation Union) protected area categories as a way of establishing how the IPA will meet conservation goals and standards (Bruce Rose, Anna Morgan, AGDEH, project interview December 2005).

Funding from the IPA program is fundamental to efforts of spinifex desert IPA landowners to look after their country. Generally it is used to fund an IPA coordinator, and some goes to employ landowners, usually via CDEP. The employment of a coordinator gives the landowners capacity to seek other sources of money for projects. LMUs have a strong role in spinifex desert IPAs integrating what landowners want to do with available support. In some other IPAs landowners work directly with IPA program staff and there can be capacity issues with understanding the ground rules, making and delivering to contracts and reporting (Bruce Rose, Anna Morgan, AGDEH, project interview December 2005).

IPA funding is relatively stable from year to year for the term of NHT2, unlike shorter term project grants. Allocations are based on a work program that is negotiated and monitored by the AGDEH IPA program staff and the landowning/grantee organisation. Problems that impact on the planned work program are assessed on a case-by-case basis and variations to the contract are negotiated. Delivery on contracted works is affected by a wide range of events such as equipment failure, floods, and people not being available to do the work due to funerals, football or other events. Program funding means that landowners have enhanced capacity to go out on country. Biodiversity outcomes start with this because landowners notice changes, assess condition and what actions they need to take (Bruce Rose, Anna Morgan, AGDEH, project interview December 2005).

Incentives

IPA program grants provide a financial incentive. These are relatively small (~$90,000 pa for each IPA) relative to the size of IPAs in spinifex deserts. Hence, attracting a range of other investments is important to IPAs' sustainability as privately managed protected areas.

Workshop participants consider the IPA 'brand' as a mark of the credibility of landowners' intentions and efforts in looking after country and an attractor for other management support/investment.

Other incentives in the IPA program include:

- recognition – of the intrinsic value of the land, of landowners' knowledge and rights to speak for that country
- enhanced networks for landowners
- feedback on management efforts and celebration of achievement.

The IPA program has a key role in fostering networks and feedback through IPA manager meetings, monitoring progress on the work program and field visits by staff, ministers and advisory committees. Because the program uses IUCN standards for protected area management, the basis for recognition of landowners' commitment to conservation and their management efforts is independent of landowners' very varied relationships with state government conservation agencies.

Loss of income from foregone land uses is not a significant consideration in landowners' decision to declare an IPA since most IPAs have no competing incompatible land uses. Sustainable production from natural resources (including through livestock grazing) is accommodated in IUCN's objectives for protected areas, particularly in category 6. Some IPA landowners consider that mineral exploration/mining is an incompatible land use. It is also inconsistent with IUCN standards for Category 1–4 protected areas (IUCN WCPA 1999). However, the extent of conflict is yet to be tested in IPAs.

Measuring change

Notwithstanding the broad range of objectives that landowners include in their IPA management plans, the IPA program is accountable to government for conservation outcomes, not for social and economic outcomes. Further, the IPA's value as a brand, in terms of attracting investment that support landowners' achievement of their goals, will ultimately depend on the extent to which landowners are able to demonstrate high biodiversity conservation values and outcomes for biodiversity conservation from investment. Staff of some LMUs see a risk that the brand will not realise its potential value because, Australia-wide, some IPAs include markedly degraded lands, many have been declared without regard to priorities for biodiversity conservation, and there is little systematic monitoring for biodiversity conservation outcomes.

The IPA program does not require monitoring in relation to biodiversity or land condition. Most IPAs have some monitoring frameworks such as photopoints, and projects undertaken in the IPA have some direct measures related to biodiversity (e.g. nest counts at mallee fowl sites in the APY lands). Monitoring needs to be done in a way that does not put an extra burden on the people who are 'on the ground' (Bruce Rose, Anna Morgan, AGDEH, project interview December 2005).

IPA landowning organisations identify a range of benefits beyond conservation outcomes in responses recorded in the IPA programs' monitoring and evaluation framework[15]. IPA program managers judge the program to be successful as a conservation program in terms of the delivery of contracted works measured by outputs such as fence lines constructed, and field work hours engaged. One reason for the program's success is that it does not force Aboriginal landowners' priorities and ways of operating into a biodiversity framework – it allows their cultural perspectives to flavour how they respond to the opportunities the program provides. IPA landowners/ management organisations give strong support and feedback about the program's effectiveness and continue to engage with the program (Bruce Rose, Anna Morgan, AGDEH, project interview December 2005).

Engagement with landowners

The IPA program supports landowners to achieve their private objectives related to land and does not emphasise public benefit related to biodiversity conservation in its engagement with landowners. This, and an emphasis in engagements between program managers, landowners and LMUs on flexibility and negotiation, could be taken to indicate that relationships are valued over biodiversity conservation outcomes. This needs to be balanced with a realistic appreciation that:

- Aboriginal landowners' goals, while not congruent with biodiversity conservation, have a relatively high degree of resonance
- trusted relationships are critical to achieving mutual understanding about goals
- there are enormous challenges in working out how biodiversity conservation can be most effectively achieved in these large IPAs given resource and capacity constraints.

While spinifex desert IPAs encompass large areas of land, relatively few landowners are actively involved with them as champions, managers or in planning or directing implementation of on-ground projects. The implications from this low level of involvement are different between each IPA. For example, there is only one relatively small settlement in each of the two IPAs in the APY lands. The landowners living there are integrally involved in all aspects of IPA management but are only a small proportion of the overall membership of the landowning body and of the collective of people with claims to some property rights. In contrast, there are eight settlements in the Ngaanyatjarra IPA with a combined total landowner population of about 2,000. The capacity of the LMU to engage any more than a small number of these people in IPA management is very limited. Community development goals for 2004–09 include action by community councils and landowners to identify and address land management issues in the parts of the IPA of most interest to people in each settlement (Ngaanyatjarra Council 2003).

15 Analysis by IPA program managers of the incidence of positive social outcomes reported by IPA communities from their IPA activities shows:

- 95% report economic participation and development benefits
- 60% report positive outcomes for early childhood development
- 85% report improved early school engagement
- 74% report a positive contribution to reduction of substance abuse
- 74% report contributions to more functional families by restoring relationships and reinforcing family and community structures

(Bruce Rose, pers comm. 2006; and see Hunt 2006)

Market production from biodiversity resources

Aboriginal landowners in the spinifex deserts use or engage with biodiversity resources in production for markets through harvesting bush foods and timbers, mustering feral animals, and cultural tourism. Most of this enterprise is small scale and much of it is linked to formal NRM activities in that it is supported by LMUs or other agencies and subsidised by grant funding. Commercial bush harvest of plant foods in the region north of Alice Springs is an outstanding exception, as discussed below (and see Walsh et al 2006).

Commercial bush harvest of plant foods

Commercial bush harvest of plant foods is relevant to incentives for biodiversity conservation because:

- it provides a unique example of market activity that supports Aboriginal activities on country – including maintenance and transfer of traditional knowledge, practices and know-how – which are important to the capacity of Aboriginal people in this region to contribute to biodiversity conservation
- it appears to enhance biodiversity conservation in harvest areas
- it provides an example of a metric that is readily understood by Aboriginal people
- it does not involve government funding or support from Aboriginal organisations and hence allows the motivations and incentives for harvesters and their interaction with landowners to be examined without as many confounding factors as are often present in the region
- threats to harvested resources are readily appreciated by harvesters, providing a potential point of engagement for planning and action on biodiversity conservation.

Commercial bush harvest of plant foods takes place in the region on Aboriginal-owned land, on pastoral lease and along road verges. Most harvesters are middle-aged and senior women. Institutions from customary law and family relationships as well as availability of resources determine where and how harvest happens. Long-term relationships of mutual dependence with a small number of wholesalers allow harvesters to be aware of and respond to market signals. Box 3 (below) describes the characteristics of bush harvest activity in terms of the attributes that enable Aboriginal people to undertake it and factors that inhibit its further development.

Indications are that bush harvest supports biodiversity conservation in that:

- harvesters go to recently burnt areas for best harvest of some species (notably desert raisin, *Solanum centrale*, one of the most commonly harvested species). In regions where there has been continuous market demand for 30 years there are indications that burn patterns are orientated to production of the harvested species. This suggests that the expectation of selling the product leads to people burning.
- a diverse suite of species is harvested/sold.
- traditional knowledge, skills and practices are maintained and passed to younger generations through involvement in harvesting.

Metrics in this system are very straightforward. Wholesalers measure value by the quantity of product supplied to specified standard. Harvesting takes a lot of time and skill and if this were to be assessed at an hourly rate the returns are low. Nevertheless, harvesters continue to engage with wholesalers indicating that the financial return is sufficient, given the other benefits they get from engaging in the harvest, and given the lack of alternative higher value ways of using their time.

The market for bush harvest product is too small for landscape-scale biodiversity outcomes to be levered from this activity throughout the spinifex deserts. Further development of bush harvest activity is also limited by harvesters' difficulties in accessing vehicles and fuel. Government investment in developing markets for bush-harvested product could potentially extend biodiversity outcomes. Also, given the strong basis of social capital that underlies bush harvest, a microfinance scheme might be an effective way to support harvesters to address cash flow limitations on their activities.

However, there is also a strong risk that action by government to apply incentives to enhance biodiversity conservation through bush harvest would have perverse outcomes such as stifling harvesters' initiative and control of the activity, which seem to be key factors in its appeal. A more effective role for governments would be to ensure that bush harvest of plant foods is recognised as a land use, such that the bush harvest values of vegetation are considered in applications for clearing or other development; and to facilitate cooperative approaches to fire management on pastoral leases that take bush harvest values into account.

Box 3: Commercial bush harvest of plant foods – a market-driven land use

Bush harvest is one of few market-based opportunities for Aboriginal people in remote communities. Factors that enable and inhibit this land use are summarised here.

Enabling factors

• The industry falls outside the processes or facilitating mechanisms of government or Aboriginal organisations. Harvesters can – and do – do it themselves.

• Contracting is verbal, involving personal transactions between harvesters and wholesalers. This avoids pressures on Aboriginal people from dealing with organisations, which can be very stressful. Aboriginal people say this stress contributes to their health failing.

• The incentive structure is good because involvement is voluntary, the activity makes sense to Aboriginal harvesters, is beneficial to them and is not onerous.

• Orders are placed by wholesalers, i.e. market demand is directly communicated to harvesters.

• Wholesalers have a relationship of trust built up through repeat dealings.

• Wholesalers pay harvesters cash in hand, and harvesters expect this. This minimises the risk of trust being undermined as a result of default on payment.

• No formalised training is required for harvesters. Training and work is undertaken in a family, kin, peer context (e.g. three generations working together). It builds social capital among the group.

• Harvesting builds on existing knowledge and skill and generates pride in knowledge and skill.

• Harvesting has low infrastructure needs (car, canvas, sticks, drums).

• Harvesters negotiate access to resources with other Aboriginal people who have customary rights to use the harvest area. This takes time – three weeks in one observed case – but it does not depend on resources and support from land councils or other organisations.

Inhibiting factors

• small and uncertain market (but demand is growing)

• high variability in productivity because of unpredictable climatic conditions and cross-impacts of other land uses (e.g. grazing stock, wildfire)

• cost of fuel and access to vehicles by harvesters

• competing commercial demands on harvesters' time (e.g. art production)

• wholesalers place orders late (which may be due to lack of cash to pay harvesters, or late notice of demand from their customers)

• tensions between commercial and customary harvest. Customary harvest possibly has better health/wellbeing outcomes and better education outcomes for children because they learn more values of food. It possibly also has better biodiversity outcomes as it uses a more diverse range of species.

• remoteness and associated factors with implications for poor communications, transport and storage infrastructure.

Source: based on input by Fiona Walsh (CSIRO) to project workshop and subsequently. Derived from preliminary findings in Desert Knowledge CRC Bush Foods project, bush harvest component. See also Walsh et al 2006.

Appendix 2: *Training Nintiringtjaku*

Training Nintiringjaku is a new incentive-driven approach to building capacity among central Australian Aboriginal people to engage with training, enterprise, employment and professional development opportunities. This is an initiative of Waltja Tjuṯangku Palyapayi Aboriginal Corporation (Waltja), an Aboriginal organisation based in Alice Springs which is also a Registered Training Organisation (RTO). Waltja works to strengthen families and support Aboriginal management of and employment in community-based services such as child care, youth support and disability services in remote desert communities, particularly in southern NT. Waltja has been developing a small network of *Training Nintiringtjaku* workers who are women from remote communities.

Training Nintiringtjaku (TN) workers are knowledgeable about training.[16] Nominees for this role are strong in English and their community language, are interested in training and have community authority to speak about training issues. Their role is to help identify the training needs of people in their communities and to help deliver of appropriate training by RTOs. Waltja supports participants to develop knowledge about the VET system, expertise in training and assessment, and to gain accreditation against units of the Certificate IV in Workplace Training and Assessment. Waltja does this by bringing TN nominees from various communities together for training workshops and also by networking with TN nominees in their home communities.

The incentive system is new and still being developed so there is no evaluation of its operation in practice. Here we describe how it is planned to operate. TN workers will gain casual or contract employment with RTOs as facilitators of training delivery in their communities. They will provide negotiation and planning support, language interpretation, and mentoring for other community members, thus supporting their community to access relevant accredited training. They will support RTOs to deliver effectively in remote communities by assisting RTOs to overcome culture and language barriers in the planning, delivery and evaluation of training, thereby enabling effective client and community consultation and reducing the high risks and low completion rates associated with remote community delivery. The Department of Employment Education and Training (NT) has indicated that RTOs could apply for additional funding under the Learner Support program to cover payment of *Training Nintiringtjaku* workers.

Waltja's ongoing role in mentoring, coordinating the TN community of practice, and networking with other RTOs has been critical to the development of the TN initiative. This is what is enabling RTOs to link with TN workers and through them with the 'community market' for the training services they offer. The role for TN workers is itself a mid-level or broker role. It draws on TN workers' knowledge of the demand for training among community members and of the potential for supply of training courses by RTOs.

The structures and incentives for TN work are well matched to the motivations of the women from remote central Australian communities who are becoming TN workers. The paid work involved is part-time or casual which is appropriate to the aspirations of these women, as they are not looking for full-time work, given family and community responsibilities. An important motivation for them is their desire to see their communities develop stronger capacity for self determination. They recognise this requires more effective training for community members, particularly young people who need specific skills to achieve full-time work. While these women are already working to this

16 *Nintiringtjaku* is a Western Desert language word meaning 'purposeful learning'.

community development goal, they typically get little recognition for their efforts. The TN role brings recognition for their ongoing work and for their language skills and community knowledge. Experience in the TN role increases their capacity to engage with 'outsiders', thus increasing their confidence and their understanding of the skills needed to work effectively alongside 'outsiders'. This in turn develops their capacity to mentor young people in appropriate traditional behaviours and to instil confidence and ambition in young people. In these ways TN work strengthens the authority of the women who work in the TN role. There are financial incentives for people to work as TN workers, through payments to TN workers for assisting RTOs in delivery of training courses. However, these are less important to TN workers than the more subtle and developmental incentives outlined above. Given these motivations, further development of the TN initiative depends on the TN workers seeing outcomes in terms of increased employment and other opportunities that engage their young people.

Desert Knowledge CRC is working with Waltja to extend the TN model to 'Research Nintiringtjaku' work. Research Nintiringtjaku are people who are knowledgeable about research. Their work on research projects, paid from research budgets, will include involvement in planning, establishing relationships between external researchers and community members, liaison with researchers about the timing of community visits, interpreting and assistance to present research findings. Through this work, these people will be community-based brokers for the interactions between external researchers and community members. With ongoing mentoring, these people can be expected to become knowledgeable about what research involves, and progressively able to articulate community research priorities and engage with research priorities developed by external researchers.

(Drawn from Kate Lawrence, Training Manager, Waltja pers. comm. 2004-6; Sarah Holcombe, DKCRC Social Science Coordinator pers. comm., and see Lawrence 2005; Young et al 2006; www.waltja.org).

Relevance to incentives for biodiversity conservation

Waltja's TN initiative has lessons for design of incentives for biodiversity conservation. It shows the key role of Aboriginal organisations working at the 'mid level' and drawing on their understandings of the motivations of community members and of the market. The TN worker role also offers a potential model for recognising the role of community-based 'biodiversity brokers' – people designated with authority by their landowning group to work with 'outsiders' interested in biodiversity and to understand both outsiders' interests in biodiversity and landowners' priorities for 'looking after country'. This initiative could draw on the existing networks among spinifex desert landowners who are committed to 'looking after country', both kin networks and the foundational networks established in recent years through formal NRM activities such as IPA manager meetings, a Threatened Species Network workshop in 2004 at Dryandra, the National Indigenous Land and Sea Management Conference hosted by CLC in 2005, and cross-border land management meetings in the spinifex desert region. Given its focus on biodiversity, such a network would have most value if it operated on a biogeographic regional basis, rather than only within one jurisdiction or nationally. Developing it will depend on engaging 'mid level' organisations to mentor the network and develop the broker role, in the same way as Waltja is doing with its TN initiative.

Appendix 3: Property rights on Aboriginal lands

Property rights of individuals and of the collectives they belong to both need to be taken into account in the design of contracts. This is because of the interface of statutory and customary institutions on Aboriginal-owned rangelands. Statutory freehold titles, Crown leases and native title vest ownership in a corporate body whose members comprise a collective. Within that collective, the rights and responsibilities of individuals in relation to the land and resources are largely determined by common property institutions derived from Aboriginal custom and tradition. The importance of these customary institutions is recognised in statutory titles under the *Aboriginal Land Rights (Northern Territory) Act* 1976, South Australia's Pitjantjatjara and Maralinga Tjarutja Land Rights Acts and in native titles. This legislation prescribes how title-holding bodies and their agents (notably CLC for NT parts of the spinifex desert region) must take these customary institutions into account in decisions about land management and use of natural resources. For Crown leases (such as special leases in Western Australian parts of the region and Aboriginal-owned pastoral leases) these common property institutions are reflected to a greater or lesser extent in the constitutions and operational rules of the landowning corporations.

Dynamic customary institutions

The spinifex deserts are the traditional territory of a number of different Aboriginal language groups. It is misleading to consider customary ownership rights as belonging to some fixed groups of people for defined bounded resources because:

- among these language groups individuals tend to be able to access a variety of pathways to claim customary ownership rights to resources at particular places
- the autonomous actions of individuals and negotiations within the group have significant impact on how property rights are distributed.

For example, among the Pintupi knowledge of country and ownership are integrally related such that an individual person who seeks to convert claims into an entitlement must convince others to include them in knowledge and activity in a way that shows acceptance of their claims (Myers 1982). Myers (1982) emphasises that it is not meaningful to talk in terms of bounded groups of people and territories. He illustrates that an individual will have a home area, and will refer to other people as being from one country/camp if they share ritual ties to other named places, or are part of that individual's particular social network and people with whom one is likely to camp and cooperate in the food quest. The composition of a band or group of socially and territorially connected people is the outcome of decisions by individuals and such groups are constituted differently depending on the standpoint of particular individuals.

Peter Sutton explores some associated complexities at length in relation to contemporary expression of native title rights (see Sutton 1998, 2001a, 2001b). He warns that frequently "it can be impossible for the outside observer to come to 'certainty' as to 'who exactly' holds which rights in what areas". While default mechanisms may have operated classically (i.e. before colonisation) to determine the area where an Aboriginal person has primary or core rights, they are not clear cut today. An Aboriginal person 'cannot make a unilateral decision about which ancestor's country is their own primary country' – they always have to muster support and recognition from others (Sutton 2001b:16). Although lack of economic attachment to land and natural resources has been eroding Aboriginal people's knowledge of country these political processes are very much alive whenever there are prospects of activities that will impact on cultural values of country and/or return benefit to traditional owners of country.

The scale of the political processes through which individuals, family groups and broader collectives such as the members of statutory title-holding bodies negotiate their property rights varies depending on the issue. For issues concerning mining, where landowners typically see a high risk of damage to valued resources and high potential for financial gain through compensation payments and royalty equivalents, very many people need to be involved. For issues around biodiversity conservation the numbers are typically much smaller. However, it is often not easy for landowners to consider land use and management separately from community development issues such as youth employment, law and order, etc, and these issues concern very many members of the collective.

These political processes are costly in time and resources but they also constitute the contemporary context in which Aboriginal culture is affirmed and reproduced. They are integral drivers of Aboriginal people's motivations for activities on country and participation both in ceremony and in formal NRM programs. In engaging with these processes, people may advance their own authority in relation to land and resources and their claims for benefit from land and resources. People may also fear the consequences for loss of authority and benefit if they do not participate.

Because property rights are so dynamic, the act of contracting will influence them. Contracts which engage particular people to produce biodiversity benefits will enhance those people's property rights compared with those of other members of the collective. Enhanced authority is a result of the social capital from enhanced networks with people outside the community, material benefits from the contract, the capacity these confer to spend more time on country, and the greater knowledge of country that results. These impacts on customary institutions could be positive for biodiversity conservation provided that contracted parties are actually motivated to produce biodiversity benefits rather than just to enhance their own authority. Some such positive impacts appear to be already resulting from the declaration and management of IPAs.

The significance of knowledge

Ownership and transmission of knowledge is interrelated with ownership of resources. It is localised and specific both to places and individual people – law belongs to country and people (Rose, 1996). Access to knowledge within clan and tribal groups has always been heterogeneous. Successive rites of ceremonial initiation continue to be undertaken in this region when individuals are deemed ready and responsible, taking into account both kinship and the attributes of individuals. As such, the actual information people possess and what they are allowed to teach, exchange and inherit varies greatly between individuals. Rights to 'speak for' particular areas of country, such as in consultations or negotiations about land use decisions, are also the province of particular individuals. It is this non-universality of knowledge that makes it a valuable resource to individuals. Its market value is realised by individuals in two main ways:

1. when individuals are engaged by agencies from a range of sectors (e.g. health, education, policing, mining, natural resource management) to determine how proposed works or other activities must be undertaken in order to be acceptable to Aboriginal landowners or cultural custodians
2. in asserting rights to share in proceeds of resource rents (especially royalty equivalents and compensatory payments made to Aboriginal landowners from mining activities).

Transmission of knowledge relied on personal transmission in oral traditions of story telling, ceremony, song, dance and design, and in situ learning based on the practical experience of travelling through country and living on, off and of the country (Rose 1996). Information about land and country derived from traditional knowledge systems is increasingly transmitted through bilingual programs in school, cooperative scientific research, educational field visits, youth education programs (e.g. the Tangentyere Council NHT-funded Land and Learning Program), and in recorded formats including video, radio and book production and archiving of materials. Effective protection of Aboriginal people's cultural and intellectual property is of great concern to Aboriginal leaders and representative organisations (see for example CLC 2005b). This needs to be well accounted for in any situation where the biodiversity outcome being sought is related to improved information on biodiversity resources and their condition.

Identity and authority of parties to a contract

Establishing who to contract with for biodiversity benefits is not straightforward because of the interface between statutory and customary property rights. Should a contract be with the body that holds title to the land/tenure parcel? Or with an individual or family group (or a corporation so constituted) with customary rights and responsibilities for part of that land? Either option is possible in principle but both options need to address the relationship between the property rights of individuals and of collectives because:

- A title-holding body that contracts to produce biodiversity benefits must have effective mechanisms – social controls or enforceable by-laws – to ensure that its members use the land in ways that are consistent with the contract.
- The rights of individuals or family groups (including family-based corporations) to determine how land is to be managed need to be recognised and authorised by the title-holding body in order for those individuals/family groups to be in a position to contract.

A third option is to contract with a local/community government council, resource agency or some other non-government organisation. Such organisations must themselves have effective mechanisms to contract with the landowning body and the landowning body must have effective controls in relation to the way the land is used by its members.

Other commercial land uses on Aboriginal lands, such as livestock grazing, address this situation by the landowning body granting leases or licences over all or part of the land to a corporate body constituted by some of its members (or to external parties). However, lease or licence holders can face difficulty in excluding customary use. This could present problems for biodiversity contracts. For example, an individual or family group may be contracted to produce biodiversity benefits by poisoning feral predators and patch burning, but people with customary use rights may set fires in the area for other purposes such as hunting, disrupting the managed fire regime. The contractor must rely on social controls for exclusion.

Establishing social controls can be costly (in time, social capital and financial pay-offs) but is integral for sustainable use of collectively-owned natural resources (see for example Ostrom 1990, 2005; Agrawal 2002; Rose 2002). In contemporary Aboriginal Australia, re-establishment of effective social controls for land use is part of the governance challenge that is a pre-eminent issue in very many remote Aboriginal communities and landowning groups.

Duty of care

The duty of care of Aboriginal landowners for biodiversity conservation is even less clear cut than for other rangeland landowners. Statutes may imply or even specify that Aboriginal landowners are bound by the same regulations and duties of care as other landowners in relation to water quality, soil erosion, fire management, weeds and wildlife conservation, etc. Nevertheless, this does not translate to any agreed understanding between government, Aboriginal landowners and their representative organisations.

For example, the *Aboriginal Land Rights (Northern Territory) Act* 1976 (ALRA) provides that “an Aboriginal or a group of Aboriginals is entitled to enter upon Aboriginal land and use or occupy that land to the extent that that entry, occupation or use is in accordance with Aboriginal tradition” (section 71a). It also provides that the Northern Territory government may make “laws providing for the protection or conservation of, or making other provision with respect to ….wildlife on Aboriginal land” (section 73(1c)) provided, among other things, that those laws are able to operate concurrently with the ALRA. Interpretation of the rights and the duty of care of Aboriginal landowners in relation to biodiversity conservation hinges on the meaning of ‘Aboriginal tradition’. A specific example is the case of commercial bush harvest of plant products. The *Territory Parks and Conservation Act* specifically requires that people (including Aboriginal people) require authorisation under that act for this or any commercial use of wildlife (section 67, 112). From one perspective this provision can be seen as able to operate concurrently with the ALRA, and therefore to apply to Aboriginal lands as much as to other lands. From another perspective the requirement to obtain authorisation can be seen as inconsistent with ‘Aboriginal tradition’ and therefore not applicable to Aboriginal lands. In current practice, harvesters are not aware of any government requirement for authorisation and the NT government does not enforce the requirement even though officers tend to see it as applicable.

Lack of a defined baseline for Aboriginal landowners’ duty of care in relation to biodiversity generates considerable risk and uncertainty for application of incentives for biodiversity outcomes. In particular, incentives will generate social inequities at a broad scale, particularly in relation to non-Aboriginal landowners, if they are applied to achieve outcomes on Aboriginal land that are already addressed or required by regulation.

Appendix 4: Shared Responsibility Agreements

Shared Responsibility Agreements (SRAs) are new institutions for government, other organisations and Aboriginal community members enabling agreement on the investment they will each make into outcomes that are important to the community. They are designed to introduce flexibility and responsiveness into government relationships with Aboriginal people in relation to local-scale investments. They do not relate to citizen entitlements such as social security benefits but to more discretionary investments in community development – the kinds of investments that are typically supported by significant volunteer effort in non-Aboriginal communities. Regional Partnership Agreements (RPAs) are intended to operate at a broader scale than SRAs. They promote coordination of government investments to meet identified priorities for a region. One RPA has been signed, for the Ngaanyatjarra lands.

SRAs are non-legal and non-binding and are driven by incentives. Where government funding is involved in implementing the SRA, a standard funding contract is also made with an appropriate incorporated body. This is legal and binding.

Typically, SRAs introduce or codify expectations for how community members will behave or what they will contribute from their own resources to achieve the agreed goals and outcomes for the SRA. These constitute the community investment in the SRA. They include rules such as ‘no school, no pool’ and ‘user pays’ for maintenance of facilities where capital costs have been funded by government; community responsibilities for use and care of equipment; or investments of volunteer effort to organise events that use new or upgraded facilities. The financial and other investments by government are the incentive for these behavioural changes. Mechanisms for monitoring change are included in SRAs. At a broader scale governments measure outcomes from SRAs and other interventions against the nationally agreed indicators for *Overcoming Indigenous disadvantage* (SCRGSP 2005).

SRAs in the rangelands

In 2004 and 2005, in the first phases of SRA development, the Australian government and other parties made 61 SRAs with Aboriginal communities in or near rangelands in NT, WA and SA. Analysis of their provisions[17] gives some indication of community development priorities although there are inevitable biases due to the small number of agreements made to date and limitations on government and community capacity as people get used to this new way of doing business. Eighty-five per cent of the communities who are partners in these SRAs were residential communities (i.e. populations of towns and settlements) although the policy framework provides for a broad definition of ‘community’ to include family groups, landowning groups and other communities of interest. Half the SRAs have a main focus on developing better support and more opportunities for youth through recreation, sport and education. Ten per cent of these SRAs make some mention of natural or cultural resource values or management issues. Only one is directed at a natural resource management issue – feral animal control to address impacts on a domestic water supply.

At the same time as SRAs are being developed, reforms to social security policy are being introduced. These rely more on sanctions than incentives to change behaviours. The reforms include removal of ‘remote area exemptions’ that apply in remote Aboriginal settlements. These have exempted Aboriginal people who are in receipt of unemployment benefit from requirements to be actively seeking work, in recognition that there is no labour market in remote settlements.

17 Based on SRA provisions set out at http://www.indigenous.gov.au/sra.html, as at 16 December 2005

This reform is being implemented progressively in settlements that agree to the change. It is often welcomed as an alternative to passive welfare and 'sit down money' although it does not in itself generate any employment market in settlements. Capacity of Centrelink, job network and training providers to respond to new demand generated for their services constrains the pace of implementation. CDEP reforms are also being extended to remote settlements, with requirements for CDEP participants to move into non-CDEP jobs within defined time frames.

SRAs are innovative and there are many different opinions about their appropriateness. There is a fair degree of distrust among Aboriginal people and others, uncertainty about their potential outcomes, concern about their impact on Aboriginal rights and conflation of attitudes to the incentive-based SRA approach to 'discretionary' investment and sanctions-based reforms to welfare entitlements. Because SRAs are new there is not yet much experience of how they can best realise their potential.

Some SRAs made to date have institutional weaknesses as incentive mechanisms, in that they depend on action by parties who were not involved in setting up the rules. For example changes in community behaviour involves action by many community members, but not all will be signatories to the agreement or fully involved in negotiations. Delivery on government commitments to provide new facilities will involve procurement of supply from other parties with attendant uncertainties of supply and quality. A further structural weakness is that monitoring does not necessarily provide for feedback to community members whose behavioural change impacts on the outcomes. Such institutional weaknesses will impact on whether Aboriginal people and governments develop confidence in SRAs as an effective policy mechanism.

Relevance to incentives for biodiversity conservation

SRAs and RPAs have potential as mechanisms for integrated investment by government in integrated outcomes that could potentially include biodiversity conservation. Several initiatives now underway in the spinifex deserts involve negotiations that are seeking to harness this potential.

Part 3: Scoping a biodiversity metric for conservation incentives, using the Stony Plains bioregion as a case study

Anita Smyth

Robert Brandle

Mike Fleming

Russell Gorddard

John Read

Stuart Whitten

May 2007

Glossary

Achievement measure	An attribute, that can be measured either remotely or in the field, used for assessing outcomes of management changes made by landholders.
Biodiversity metric	A scoring system that combines complex data from multiple biological and environmental attributes into a simple, cardinal comparative unit that summarises biodiversity values.
Biodiversity condition metric	A measurement that summarises the state, health or integrity of biodiversity at a site at a point in time.
Biodiversity incentive metric	A metric used in an incentive policy to summarise the benefits of likely management outcomes for biodiversity resulting from a proposed management change by land managers. It is used to classify and rank the biodiversity benefits offered by competing management actions that are proposed by landholders.
Biodiversity performance metric	A metric that summarises the biodiversity conservation achievement or the performance of an incentive or any other conservation policy implemented for conserving biodiversity.
Biodiversity rewards	Monetary or non-monetary incentives for future biodiversity conservation outcomes, based on past 'best practice' management.
Biodiversity values	Society's perceptions of plants, animals and their habitats based on their experiences, principles, ethics and ideals of nature. For the Stony Plains bioregion, we interpreted them as the significant biodiversity assets of the region and the value placed on those assets by people of the region and society as a whole.
BioRewards-Pilot	A cardinal biodiversity incentive metric based on outcomes and developed by this project. It quantifies the relative merit of proposed (or past) management changes in retaining or restoring native vegetation/habitat, as submitted by individual cattle producers in a call for applications for incentives. The metric uses native vegetation as a surrogate for biodiversity values. It is designed not to link to any particular incentive mechanism (e.g. auctions, cap and trade schemes, offsets, devolved grants).
Call	A public offer for voluntary participation in an incentive scheme.
Condition/intervention metric	See 'Biodiversity incentive metric'.
Conservation incentive	Something that encourages change in individual land management actions. Conservation incentives are closely aligned with conservation policy objectives.
Facilitative instrument	Anything designed to improve the flow of information, and corresponding signals and incentives, without providing any direct incentive payments to land managers. Examples are extension programs that provide information about how to manage land to improve biodiversity conservation, and voluntary agreements such as 'Land for Wildlife'.
Gilgai	A depression in the landscape formed by sinking and shrinking clay, and in sites of high productivity and activity (Garry Cook, CSIRO). Often referred to locally as 'crabholes' or 'melon holes'.
Government policy interventions	Policy instruments that encourage changes in land management. They can be categorised as (1) facilitation, (2) incentives and (3) regulatory/compliance instruments.
Incentive instruments	Policies to influence societal processes and behaviour so that they align with, and remain compatible with, defined environmental and societal targets. They are designed by policy experts to directly change the structure of pay-offs to land managers and are usually intended to substitute for monetary signals that are generated within markets for other goods and services. Participation is voluntary. Incentive instruments may or may not be market-based. They are also commonly referred to as incentives, incentive schemes and incentive mechanisms.
Incentives	See 'Incentive instruments'.
Market-based conservation incentive	A conservation incentive that encourages behaviour through market signals, rather than through explicit directives.
Market-based incentives	See 'Market-based instruments'.
Market-based instruments and trading schemes	Market-based instruments encourage behaviour through market signals rather than through explicit directives regarding biodiversity conservation targets or methods. Trading-based schemes are a subset of market-based instruments that focus on policy instruments involving trading. Trading-based schemes include cap and trade schemes, auctions and information disclosure. They do not include taxes and subsidies.
Metric	A standard of measurement.
Palatable, persistent plant species	Plant species that are browsed by native, feral and domestic herbivores and are detectable and identifiable at a site after long dry periods.
Principles of metric design	A set of nine principles to guide the design of a metric for application with an incentive policy. The metric and the incentive policy are designed concurrently.
Producer's impact	A property of BioRewards-Pilot that quantifies the future success that a producer's change in management may have on the site biodiversity values as measured by native vegetation.
Regulatory/compliance instruments	Non-voluntary instruments that are designed to compel management change. Regulations designed to protect native vegetation are an example.
Resilience	'A measure of the persistence of systems and their ability to absorb change and disturbance, yet still maintain the same relationships between system variables' (Holling 1973). In the Stony Plains bioregion, the ability of ecosystems to 'bounce back' from disturbances after long dry periods.
Scoring method	The mathematics of deriving a cardinal number, based on the individual scores of the structural properties of the metric.
Vulnerability	In conservation planning, vulnerability is described by three properties: exposure, intensity and impact (Wilson et al. 2005). In our case study, impact on vegetation is influenced by the intensity of total grazing pressure (i.e. the total number of stock reliant on water sources). Exposure is mostly driven by the distribution and permanence of natural and artificial 'permanent' water points, where 'permanent' artificial waters may last 6–36 months after rain. Vulnerability is a property of BioRewards-Pilot.

Executive Summary

Introduction

This is the third technical report in the series *Enabling the market: incentives for biodiversity in the rangelands*. Here we offer recommendations on the development of a biodiversity incentive metric for Australia's rangelands. We describe:

- an integrated approach using conceptual and operational frameworks for developing regionally-based biodiversity incentive metrics for any type of incentive mechanism, market-based or not
- an application of the proposed integrated approach where we use it to design the features of a biodiversity incentive metric for the Stony Plains bioregion
- feedback on the design features from two independent sets of producers
- the structure of a prototype biodiversity incentive metric called BioRewards-Pilot specifically designed for the Stony Plains bioregion
- recommendations for developing biodiversity metrics to apply with incentive policies for biodiversity outcomes.

Biodiversity incentive metrics

A biodiversity incentive metric is a cardinal metric applied in an incentive policy. It summarises measures the benefits for biodiversity resulting from a change in management by landholders. It is used to classify and rank the competing benefits of changes in management practices proposed at local sites, so that biodiversity outcomes can be judged on their cost-effectiveness. It is one of four types of metrics used in biodiversity conservation planning where each metric is defined by its purpose. The other three types of metrics are: (1) biodiversity condition metric – used for assessing the state/integrity of biodiversity; (2) biodiversity monitoring metric – used for monitoring changes in biological variables over time; and (3) biodiversity performance metric – used for assessing the performance of policies.

> **Recommendation 1.** *Clearly define the purpose of all biodiversity metrics so that communicating their roles with end users is easier*

In the early stages of developing the biodiversity incentive metric in this project, we recognised that the incentive metric must be designed with a clear understanding of the aims of the proposed incentive policy.

> **Recommendation 2.** *Design biodiversity incentive metrics concurrently with the incentive policy and other regional conservation planning processes.*

An integrated approach linking metric design to incentive policy design

We developed an integrated approach which links the designs of biodiversity incentive metrics and of regional incentive policy.

The conceptual framework incorporates key factors that influence the design process: the concept of biodiversity, the natural ecosystem dynamics and disturbance patterns that influence those dynamics, existing regional planning processes, surrogate selection criteria, design principles for incentive metrics, and lessons learnt for the design of other biodiversity incentive metrics.

The operational framework outlines the metric design process in three stages:

1. a systematic assessment of the regional biodiversity conservation priorities

2. identification of the design features of the metric and development of the metric's structure and scoring method
3. an evaluation of the acceptance and credibility of the metric.

This integrated approach to metric design for biodiversity incentive metrics could be applied throughout Australia's rangelands, and in any incentive policy whether or not it had a market focus.

> **Recommendation 3.** *When developing biodiversity incentive metrics for Australia's rangelands, use an integrated approach that links conceptual and operational frameworks as proposed in this document.*

Developing a structure for a biodiversity incentive metric

Using the Stony Plains bioregion of the arid South Australian rangelands as a case study, we developed the structure of the BioRewards-Pilot metric to compare future biodiversity gains from management change at sites on cattle properties in a regional context for any type of incentive mechanism.

Systematic assessment of conservation issues

We summarised the biodiversity conservation issues for the Stony Plains bioregion using information in reports from regional planning processes and stakeholder and technical workshops. We identified seven broad biodiversity values and seven threats and pressures, which are being managed through 'duty of care' obligations in six state and Commonwealth acts. We also identified three priorities for biodiversity conservation for the Stony Plains bioregion, which influence the design of incentive policies for the region and guide the design features of the metric.

The systematic assessment activity required more effort than expected, so we had less time available for developing other features of the metric (e.g. the scoring method).

> **Recommendation 4.** *Make sure resources are available to refine the design issues beyond those already documented in regional plans and to run interdisciplinary workshops.*

Metric design features

Working through the operational framework, we identified the desired biodiversity outcomes, the key biodiversity values and seven achievement measures for assessing these biodiversity outcomes. After systematically working through each step of the operational framework and applying the principles of metric design (Whitten et al, unpublished CSIRO report) and the criteria for selecting surrogates outlined in the conceptual framework, it was clear that some of the original desired outcomes were not achievable, and that some of the biodiversity values and achievement measures of the remaining desired outcome did not meet the surrogate selection criteria.

> **Recommendation 5.** *When designing biodiversity incentive metrics, consider the principles of metric design for incentive policies.*

> **Recommendation 6.** *When choosing achievement measures, make sure they reflect the ecological function of the attributes representing the regional biodiversity values. To increase their scientific credibility, use the guidelines for selecting surrogates*

Feedback from producers on the metric design features

Although the metric features were specific to the Stony Plains bioregion, we tested them with producers in New South Wales and Queensland. Producers' responses showed that they understood the features well and that the features were closely aligned with their perceptions of biodiversity values. Both groups were highly supportive of a metric that uses both site visits and GIS/RS-derived data together. They did not support the use of either of these types of data alone.

> **Recommendation 7.** *To increase acceptance by producers of a biodiversity incentive metric, use a combination of field-based and remotely derived data for achievement measures.*
>
> **Recommendation 8.** *Design incentive policies and their metrics so that they are readily understood by producers and administrators. Where possible, use multiple incentives and metrics rather than a 'one size fits all' approach.*

Structure of a pilot biodiversity incentive metric

With the design features refined, we then developed the initial structure of a prototype biodiversity incentive metric called BioRewards-Pilot. It calculates a vulnerability score of biodiversity at a site, weights it by the total value of credible management for that site and the area of the management works. The regional context of this proposed metric makes it different from all other metrics.

> **Recommendation 9.** *Include regional level achievement measures in the metric structure for use as regional benchmarks.*

In summary, we have developed a prototype for the structure of a biodiversity incentive metric for the grazed lands of the Stony Plains bioregion. The predictive modelling of the regional values is either conceptual or in the early developmental stages. From this 'proof of concept', we have a good sense of the potential structural framework for a rangelands biodiversity incentive metric and the level of effort needed to produce it. With further investment in acquiring, modelling, interpreting and calibrating the spatially-derived bioregional information for benchmarking site-based information (e.g. Australian Collaborative Rangelands Information System), it will be feasible to refine BioRewards-Pilot to a stage where it could be implemented.

> **Recommendation 10.** *Invest in calibrating and further developing surrogate spatial datasets for bioregions as described for BioRewards-Pilot.*
>
> **Recommendation 11.** *Invest in formally accepting and assessing the scientific credibility of the structure of BioRewards-Pilot before refining it any further.*

1. Introduction

1.1 Aims and methods

In this technical report, we describe and evaluate an integrated approach for designing a biodiversity incentive metric for use with an incentive policy, where the aim is to improve biodiversity management in Australia's rangelands. Our study is one of four studies commissioned by the Australian Government Department of the Environment and Water Resources (formerly the Department of the Environment and Heritage) to explore the potential of market-based incentives for improving the management of biodiversity in Australia's rangelands.

In the early stages of this study, we encountered several design challenges. To identify a conceptual framework to help inform the design of our metric, we reviewed existing biodiversity metrics used in incentive instruments. While we found comprehensive descriptions of the purpose, structure and scoring methods of biodiversity incentive metrics, we found very little documentation on the rationale for their design features and how they were linked to the policy aims of the incentive instrument. Most challenging was the lack of detailed descriptions of the developmental process used to design the structural frameworks and scoring methods of these metrics. Without this knowledge, we found it difficult to assess whether existing metrics aligned with incentive policy objectives, and whether they could achieve the desired outcomes as intended. An interesting puzzle was that most biodiversity incentive metrics appeared to summarise local information at the sites of proposed management to assess the competing biodiversity benefits proposed by landholders. Rarely was this information assessed for its regional significance and its relevance to other regional conservation planning processes.

To minimise the design issues, we developed an integrated approach to metric design based on a conceptual and an operational framework. Using this approach, we then designed the structure of a biodiversity incentive metric for changes in management practices on grazed land in the Stony Plains bioregion as a proof of the concept. We tested the broader acceptance of the metric's design features informally with primary producers in New South Wales and Queensland.

We chose the Stony Plains bioregion in South Australia to develop and test the approach because incentive research was already underway for an existing project (DKCRC project 1.707, 'Rewards for biodiversity') and the South Australian government had systematic assessments of biodiversity conservation issues in the region.

We formed a team of scientists spanning the disciplines of environment policy, NRM economics and wildlife biology. As each discipline has its own terminology, it was hard to find a common language. So we developed a glossary of terms to help communicate about the project.

1.2 The roles of biodiversity metrics and incentives in rangelands biodiversity conservation

Geography, plants and wildlife shape civilisations (Diamond 1997). While geography is a primary influence on natural ecosystems, biodiversity is a key input for ecosystem services valued by society (e.g. primary production, cultural and natural heritage, outdoor lifestyles, and ecotourism). The management of biodiversity in the rangelands has received little investment despite the rangelands covering almost 80 per cent of the continent. This is largely because the landscapes are perceived to be mostly intact. However, recent State of the Environment reports suggest that rangeland ecosystems are in slow decline and are extremely vulnerable to unsuitable land uses, inappropriate fire management practices and invasive weed species (Fisher et al. 2004).

Traditionally, government intervention policies have relied on facilitative instruments (e.g. extension programs, voluntary agreements) or regulatory instruments to manage biodiversity (Part 1 this report). On private lands in the intensive land use zone of coastal Australia, incentive instruments are becoming popular intervention policies for improving management of biodiversity. They work by influencing societal processes and behaviour so that they align with defined biodiversity conservation policy objectives. Market-based instruments (MBIs) are designed to directly change the structure of pay-offs to the landholders and are usually intended to substitute for monetary signals that are generated within markets for other goods and services. The policies can also use incentive instruments that are not market-based; an example is where incentives are allocated retrospectively as part of a reward system. Unlike regulation, incentive instruments are voluntary and, although they are often regarded as independent of facilitative and regulatory instruments, they are usually nested within these (Part 1 this report).

Incentive instruments in Australia have mostly focused on market signals and are based broadly on three categories of MBIs: (i) price-based, (ii) quantity-based, and (iii) market friction (Part 1 this report). Most existing MBIs are price-based MBIs designed to directly reflect a price for the desired biodiversity outcomes, where the price reflects the value of biodiversity and the benefits of management changes. Examples are auctions/tenders, subsidies, rebates and tax incentives. For more information on other types of MBIs, refer to Part 1 this report.

When an incentive instrument such as a price-based MBI is implemented, the contractor (usually a government agency or non-government organisation) seeks an expression of interest (EOI) from landholders for proposals for land management changes (or possibly for maintaining existing management practices) to improve biodiversity conservation outcomes. The EOI may contain information on the policy (e.g. objectives, desired outcomes, measures for assessing the outcomes, and expected management changes that would produce the outcomes), the funds available, and guidelines on how to participate in the scheme. The EOI may also describe the competitive selection process of proposals for allocating incentives.

Biodiversity metrics have many purposes in biodiversity conservation but it is biodiversity incentive metrics that are used as part of an incentive instrument to assess successful proposals. So, biodiversity incentive metrics play a critical role in the operation of incentive instruments and their acceptance by the end users. In the brief for our study, metrics with this type of purpose were loosely termed ‘condition/intervention metrics’. To sharpen up this terminology, we have called them ‘biodiversity incentive metrics’.

1.3 The structure of this report

In Chapter 2, we describe the context in which biodiversity incentive metrics are used in biodiversity conservation planning, and we briefly review existing biodiversity incentive metrics.

In Chapter 3, we propose a new integrated approach for designing biodiversity incentive metrics and we describe a conceptual and an operational framework.

In Chapter 4, we describe how we used the integrated approach to develop the structure of a biodiversity incentive metric for the Stony Plains bioregion as a proof of concept. We also describe our test of the metric's initial acceptance.

In Chapter 5, we introduce a pilot structural framework for a biodiversity incentive metric to be applied in the Stony Plains bioregion using the design features identified in Section 4 as a 'proof of concept' of the integrated approach outlined in Section 3.

In Chapter 6, we draw conclusions and make recommendations.

In Chapter 7, we list references.

We provide extra background information in the Appendixes.

2. Biodiversity incentive metrics

2.1 Different metrics for different purposes

Biodiversity metrics are scoring systems that combine complex data from many attributes into a simple, cardinal number. The structure of any metric strongly depends on its purpose. In biodiversity conservation, these are four broad purposes:

1. Measuring the state, health or integrity of a site at a point in time. We refer to these metrics as 'biodiversity condition metrics'. They capture the condition of biodiversity at one point in time, mostly for the purposes of biological auditing or inventories. They tend to be static measures.
2. Tracking changes in biological attributes over time. We call these metrics 'biodiversity monitoring metrics'. They are dynamic measures that measure change reliably from one point in time to the next.
3. Classifying and ranking the future benefits to biodiversity arising from changes in management practices at a site, as proposed by landholders in a competitive bid for incentives. The metric is applied in an incentive policy whether it is market-based or not. We call these metrics 'biodiversity incentive metrics'. They are applied in a forward planning setting where the proposed management is predicted to improve biodiversity.
4. Monitoring achievement in biodiversity conservation. We call these 'biodiversity performance metrics'. In the case of biodiversity conservation, this type of metric focuses on the gains in biodiversity conservation per dollar invested as specified by a set of milestones for the life of policies.

Although we describe these purposes separately, the structure of a metric may contain features of other metrics, as is the case with biodiversity incentive metrics. Over the life of an incentive policy, it is possible to have different metrics being applied for any of the above purposes. For these reasons, we suggest clearly defining the purpose of any biodiversity metric to avoid confusion and to make it easier for people to understand how it can be applied.

When a biodiversity metric is used in incentive policies, the draft report on MBIs to the JVAP/RIRDC in 2006 by Whitten, Coggan, Reeson and Shelton (unpublished CSIRO report) states:

> *The metric is the basis for measuring relative and absolute outcomes, and therefore for defining property rights, and consequently who benefits and who pays. It represents a complex bundle of trade-offs and is not simply a question of estimating a measure of biophysical change (which in itself is extremely complex) but often must take into account other drivers of values (p. 28).*

Therefore, a biodiversity incentive metric is used to assess the likely future gains in biodiversity outcomes as a result of management changes at a site. It combines information on the state of biodiversity and proposed management changes so that potential biodiversity management outcomes listed in proposals for an EOI can be judged on their cost-effectiveness (Bryan et al 2005, Parts 1 and 4 of this report).

We stress that the purpose of a biodiversity condition metric is different to the purpose of the metric we present here, where we specifically address biodiversity incentive metrics. Properties of the biodiversity condition metric may be reflected in the design of the biodiversity incentive metric to establish the condition of biodiversity at a site, but it is the future improvement in biodiversity resulting from management changes and the link with incentive policies that distinguishes biodiversity incentive metrics from other metrics.

2.2 Existing biodiversity incentive metrics applied in incentive policies

Most biodiversity metrics implemented in Australia are biodiversity incentive metrics. They are used as a basis for specifying expected biodiversity management outcomes for outcome-based contracts of tenders/auctions (Davies and Smyth, unpublished review). The goal of these contracts is to link remnant vegetation in highly fragmented landscapes. Parkes et al.'s (2003) *Habitat Hectares* initiated interest in this area but Oliver and Parkes's (2003) biodiversity benefits index (BBI) has become the template for the design of biodiversity incentive metrics (e.g. McCosker & Rolfe 2004; native biodiversity benefits index (NBBI) by Gole et al. 2005; biometrics by Gibbons et al. 2005). BBI is a good example of the policy features and structure of a biodiversity incentive metric.

The original BBI was not directly developed as part of an incentive policy. Instead, it built on the policy aims of *Habitat Hectares*, which were to quantify the gains to biodiversity conservation from on-ground management interventions in the Victorian 'BushTender' trials. The policy features of BBI are described in Table 6.

Table 6: Policy features of the original biodiversity benefits index

Biodiversity goal	**Retain ecologically functioning native vegetation remnants in intensive land use regions of Australia**
Desired biodiversity outcome	Improvement in the vegetation condition of native remnants
Biodiversity values	For each vegetation type: • Floristic diversity • Structural complexit • Weed invasion • Landscape context • Native vegetation cover • Recruitment patterns • Risk of threat or vulnerability
Appropriate achievement measures	*Vegetation condition* • Species richness per life form groupt • Organic litter score • Hollow-bearing trees score • Level and nature of recruitment • % cover per life form group • Large trees score • Wood load score • Weeds score *Conservation significance* • Threatened status of species and communities score (least concern, near threatened, vulnerable, endangered, critically endangered/presumed extinct) *Landscape context* • Patch size • Proximity to adjacent areas of native vegetation based on its quantity and quality • Distance to core areas

Source: Oliver & Parkes 2003

The structure of BBI is based on three parameters: (i) biodiversity significance, (ii) the outcomes of changed management and (iii) the area of management works for a site, in hectares (Oliver & Parkes 2003) (see Figure 9).

The biodiversity significance score (BSS) for a site is measured by three achievement measures: (i) current vegetation condition, (ii) current conservation significance and (iii) landscape context (see Table 6).

The outcomes of changed management (land use change impact score or LUCIS) are measured by two achievement measures: (1) potential vegetation condition and (ii) conservation significance. ‘Potential’ is defined as the expected improvement in vegetation condition and conservation status as indicated by benchmark stands of the same vegetation type in a ‘natural undisturbed state’.

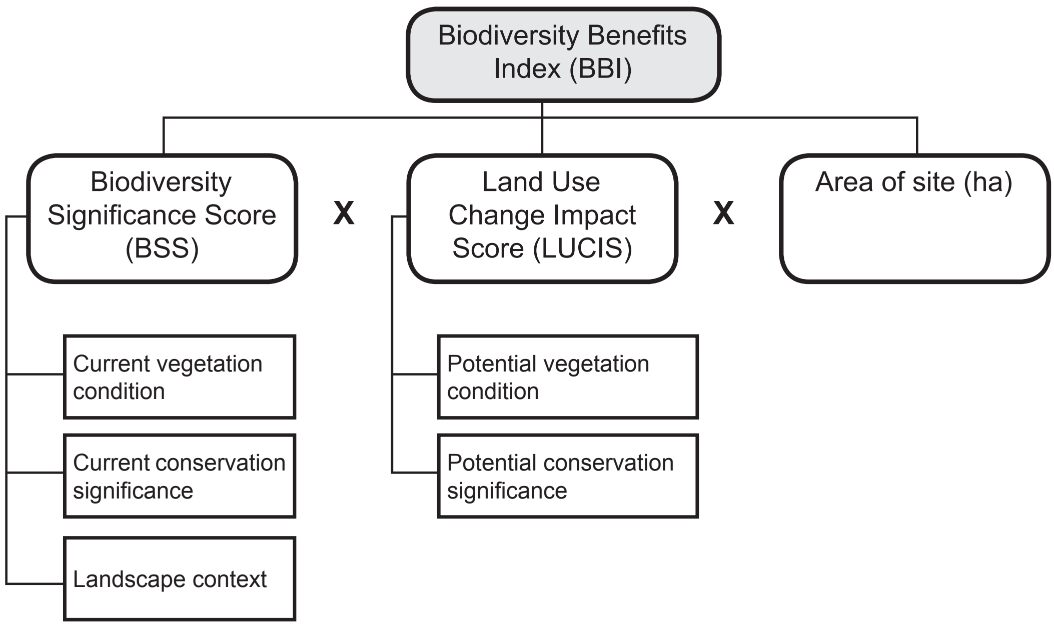

Figure 9: The structural framework of the Biodiversity Benefits Index (BBI)

Note: Sub-scores of BSS, LUCIS and area of the site of proposed management works are multiplied to give the BBI. Scores in each sub-score are added (Oliver & Parkes 2003).

Biodiversity incentive metrics based on this template are site-specific although the biodiversity values of the site (i.e. the BSS) are compared with natural ‘benchmarks’. We are not aware of any assessment procedures that compare the biodiversity site values in a regional context. For this and other reasons, the capacity of these metrics to inform planning for regional biodiversity conservation has been questioned, particularly by the South Australian Department for Environment and Heritage. However, with the recent development of the principles of metric design for incentive policies by Whitten et al (unpub) at CSIRO and the new advances in scoring methods (see McCarthy et al. 2004 and Gibbons and Freudenberger 2006 for a review), developers of biodiversity incentive metrics are now in a stronger position to improve their structural designs and scoring methods for calculating a single value.

3. An integrated approach to designing biodiversity incentive metrics

We used the methods for designing integrated systems (e.g. Dovers 2005) and program logic (e.g. Miller et al. 2001 and http://www.audiencedialogue.org/proglog.html for examples) to create an integrated approach to designing biodiversity incentive metrics. The method has three steps:

1. Identify the key factors influencing the design of a biodiversity incentive metric.
2. Develop a conceptual framework based on the key factors.
3. Develop an operational framework to depict the steps in the design process.

We propose that both frameworks have the potential to be applied throughout Australia's rangelands and perhaps other systems where the main objective is to develop an incentive metric for improved biodiversity management.

3.1 The key factors influencing metric design

Many factors can influence biodiversity incentive metric design in the rangelands, particularly when scientific uncertainty is high and the investment in information collected at the site level is low. Often designers will be required to make decisions about aspects of biodiversity and its management for which there is only anecdotal information. In these situations, designers have no alternative but to be guided by a conceptual framework. There are seven key factors that influence metric design:

1. the theoretical concept of biodiversity
2. natural ecosystem dynamics in the rangelands
3. regional disturbance patterns (e.g. threats and land use pressures)
4. the role of biodiversity surrogates and their selection as achievement measures
5. existing regional biodiversity conservation planning processes
6. design principles for metrics in incentive policies
7. lessons learnt from applying existing incentive-based metrics.

3.1.1 What is biodiversity?

An important aspect of any incentive policy is that the designers have a clear understanding of theoretical biodiversity and how to transfer that knowledge to landholders. It is important that biodiversity is communicated in a consistent, unambiguous style so that the administrators and end users of incentives have a shared understanding.

Biodiversity is the variety of all life forms including plants, animals, the genes they contain, their habitats and the ecosystems of which they are a part. It can be measured as attributes of composition (e.g. species richness), structure (e.g. diversity of age classes) and function (e.g. resilience of native vegetation), mainly at the ecosystem or habitat level of biological organisation, i.e. ecological communities (see Figure 10). This meaning of biodiversity is well-recognised among biologists, but outside the realm of science it is often interpreted in almost unrecognisable ways. Most importantly, biodiversity excludes physical components and processes (e.g. nutrient cycling, movement of water or energy), ecosystem service categories that involve harvesting biota (e.g. pasture production, timber harvesting) or culturally-based categories (e.g. cultural, spiritual or aesthetic objects) (Sarkar & Margules 2002).

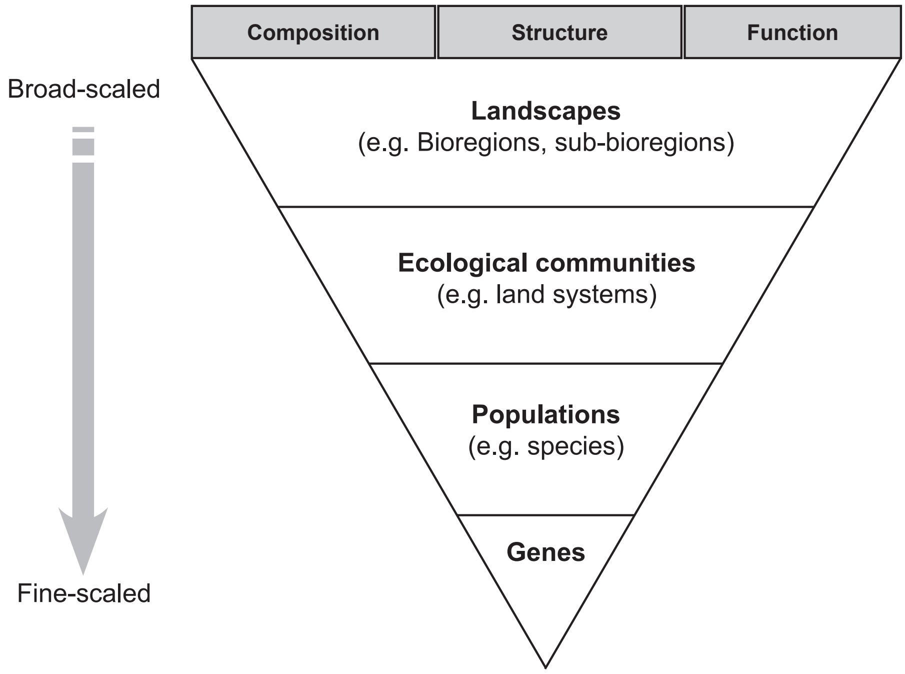

Figure 10: The theoretical concept of biodiversity

Note: The compositional, structural and functional aspects of the theoretical concept of biodiversity at different levels of biological organisation from broad- to fine-scaled levels (adapted from Noss 1990; Dale and Beyler 2001)

Using the concept shown in Figure 10, we can measure many different attributes on the ground (see Table 7). Attributes that can be measured from site to regional scales tend to be more useful because incentive policy design tends to focus on site information for a regional outcome that is aligned with existing regional planning processes (Part 1 this report).

Table 7: Examples of biodiversity attributes that can be measured on the ground

Biodiversity Attributes at Broad Scales

	Composition	Structure	Function
Landscape/ Region	• identity • distribution • richness of patches	• spatial heterogeneity • patch size, shape, distribution • connectivity • fractal dimensions • metapopulation dynamics	• fragmentation • migration/dispersal • extinctions • landscape function • resilience • colonisation, relaxation • disturbance regimes • vegetation condition
Ecosystem/ Community	• species composition-identity, abundance, richness, evenness, diversity, similarity coefficients, life form distributions, cover, biomass • + & % focal species • dominance diversity curves	• living & dead biomass • canopy openness • gap characteristics • abundance & distribution of physical features • water & resource presence & distribution	• productivity • decomposition • herbivory • parasitism • predation • pollination •competition • succession • disturbances
Population/ Species	• +/-, abundance, %, • density • importance • conservation status • disturbance tolerant/ intolerant	• population size, structure & range • dispersal	• population changes • physiology • photosynthetic rates • foraging success • growth rates • reproduction rates

Note: The attributes shaded in grey are commonly used in regional biodiversity conservation planning and management (adapted after Noss 1990, Dale and Beyler 2001).

Biologists have identified four broad measures of biodiversity (Ferrier 2002):

1. alpha diversity – diversity in a site (e.g. species richness or any other compositional grouping)
2. beta diversity – diversity among sites (e.g. complementarity)
3. gamma diversity – total diversity of a region (e.g. geographical isolation)
4. a mix of beta and gamma diversity – spatial turnover of community composition between pairs of sites in a region.

3.1.2 Ecological dynamics, disturbances and impacts

Credible biodiversity incentive metrics for managing biodiversity will be underpinned by an understanding of the ecological dynamics of rangeland ecosystems at landscape scales over decades (Kerle et al. in press). This is because biodiversity surrogates are used as achievement measures in biodiversity incentive metrics and we need to know how they respond to diverse climate and disturbance patterns over time from one place to the next. Designers will need to choose appropriate surrogates, as discussed in Section 3.1.3. Often, wildlife biologists do not fully understand such complexity at regional scales because the field studies are lacking. This is particularly evident in the eastern arid rangelands (Kerle et al. in press). Metric designers therefore have to rely on their theoretical knowledge to fill in these gaps when developing metrics.

The ecological dynamics of terrestrial biodiversity are mainly affected by water availability and soil properties such as nutrients, infiltration and biota (Stafford Smith & Morton 1990). Fire is an important driving force although not in places like the stony deserts. Desert landscapes in general have infertile soils and unreliable, intermittent water supply. Dry periods tend to be common and longer than in the wetter parts of Australia, although the past 50 years in the arid landscapes have been a period of increasing rainfall and ground water (Kerle et al. in press).

Although broad unproductive landscapes dominate, there are distributed within them relatively fertile patches that are higher in nutrients. These pockets receive relatively reliable intermittent water from extra surface run-on, or deep sub-surface water, and tend to support higher plant diversity, growth and palatability. They are significant places for some resident animal species and for those that disperse widely in search of resources (e.g. nomadic grasshoppers, birds and mammals). They are also favoured by livestock. This patchiness of biodiversity values and disturbance has profound implications for biodiversity conservation.

Such environmental variability occurs at a scale far smaller than a biodiversity (or pastoral) management unit and the temporal variability characteristic of arid landscapes means that there is no one recipe for managing biodiversity. Instead, flexible and adaptable management strategies are needed and this applies equally to incentive policies and their metrics.

Grazing is the most widespread land use of natural ecosystems in the rangeland (Smyth & James 2004; Whitehead 2001). The invasion of wild stock[1] has substantially increased grazing pressure, especially in fertile pockets of some regions (Fisher et al. 2004). The spread of permanent waters by artificial means (e.g. troughs from bores, bore drains, dams) provides extra grazing opportunities that have in some places resulted in habitat loss and degradation (James et al. 1999). These areas vary in shape and distance from water depending on the vegetation type and topography of land types.

1 Domestic stock, feral herbivores and increased kangaroo populations.

Another grazing-related practice influencing habitat loss and degradation is the clearing of woody vegetation for exotic grasses, although it occurs more in the savannas and semi-arid areas. In addition, weeds are spread via road networks and drainage lines (e.g. ~700 weed species occur in the rangelands (Grice & Martin 2005). Weeds are predicted to exert more severe pressure as CO2 increases in our atmosphere (Howden et al. 2003). Introduced predators (feral cats, foxes and feral dogs) are widespread and have already had an adverse effect on native animal populations, especially at water points (Edwards et al. 2004), although cats have had less of an impact in the stony deserts (Brandle 1998). Natural fire patterns have been changed substantially and will continue to change due to the invasion of exotic perennial grasses as predicted by climate change scenarios (Howden et al. 2003).

Native biodiversity of the rangelands provides the building blocks for ecosystem services. It is everywhere in all places and its ecological dynamics are continually changed by natural and unnatural means. All the same, it is impossible to know everything about biodiversity in all places, and therefore these gaps in knowledge mean that surrogates have become widely used in managing it.

3.1.3 Biodiversity surrogates

Surrogates can take the form of a true or estimator surrogate (Sarkar & Margules 2002). ‘True surrogates’ measure actual biological attributes (e.g. vegetation cover as a surrogate of biodiversity) whereas ‘estimator surrogates’ are often environmental or disturbance attributes that are used to estimate biotic information (e.g. topography, climate and distance from water point). We distinguish between these two types of surrogates to emphasise differences between direct and indirect representation of biological attributes. Both types of surrogates can be measured using either raw or modelled data.

Selecting appropriate surrogates is critical to the robustness of any biodiversity incentive metric. Apart from the work of Read and co-workers (1999, 2000, 2002, 2004, 2005) and Fuduka (2006) who investigated the potential of true surrogates (e.g. chenopod shrubland plants, ants, birds and reptiles), there is little information to guide surrogate choice for Australia’s rangelands (Smyth et al. 2003). While Sarkar and Margules (2002) outline the importance of choosing appropriate surrogates, another equally important issue influencing metric design is the number of surrogates to use and whether they are a sufficient and necessary set to address the complexity of biological diversity. Smyth and James (2004) have outlined some broad guidelines to consider when choosing surrogates (see Table 8) but they acknowledge that some of these are difficult to apply as they rely on considerable scientific knowledge. Read and co-workers (1999, 2000, 2002, 2004, 2005) and Fuduka (2006) have suggested that, in dry times, perennial vegetation cover – in particular, grasses – is the most appropriate surrogate in the arid chenopod communities of South Australia and western Queensland. It is also likely that landholders will readily accept this surrogate.

Table 8: Guidelines for selecting biodiversity surrogates

Selection criteria for biodiversity surrogates
Biodiversity surrogates:
1. are easily measured
2. their costs are appropriate to their benefits (including non-economic costs and benefits)
3. are sensitive to threatening processes affecting the system
4. respond to threatening processes in a predictable manner with known levels of confidence, and biological and statistical power, i.e. have low variability in response
5. are anticipatory: signify an impending change in the ecological system whether compositional, structural or functional aspect of biodiversity with confidence
6. predict changes that can be averted by management actions
7. are integrated: the full complement of indicators provides a measure of coverage of the key gradients across ecological systems (e.g. water, soils, vegetation types, climatic profiles)
8. have a known response to natural disturbances, threatening processes and changes over relevant spatial scales and timeframes
9. have low variability in response
10. are capable of being measured against a standard or other performance measure, where relevant
11. retain flexibility to incorporate new information as it becomes available or circumstances change
12. link with existing Australian state and territory indicators for pastoral monitoring, Parks & Reserves programs, and the National Land and Water Resource Audit minimum set
13. are easily used under different scales of rangeland NRM and different tenures
14. facilitate community involvement where possible and appropriate.

Note: Guidelines to use in the design of biodiversity incentive metrics

Source: (Smyth & James 2004; Carignan & Villard 2002; Landsberg et al. 1999)

3.1.4 Linking metric design to regional biodiversity conservation planning

Biodiversity metrics are tools for incentive policies that tend to have a regional focus (Part 1 this report). Logically, biodiversity incentive metrics must be developed within a regional biodiversity conservation planning process. This means not only should metrics measure the benefits of management change to biodiversity conservation at the site of management change but, more importantly, it should also indicate the contribution of the site in a regional context. If not, biodiversity conservation will be perceived as ad hoc and lacking a strategic approach.

To give metric design a regional focus, several steps need to be followed in the design process. The first step is a systematic assessment of the regional biodiversity conservation issues to identify conservation priorities. The next step is a pragmatic analysis of the desired features of the biodiversity incentive metric. Input by regional biodiversity conservation planners is required in the initial technical stages of the systematic assessment; then landholders and other stakeholders must be engaged in determining biodiversity values. Investment in participatory workshops is necessary to get comprehensive input.

The outputs of this process provide the metric designer with a clear statement of the biodiversity conservation goals, the desired conservation outcomes and the biodiversity values underpinning the desired outcomes that align the regional priorities.

3.1.5 The principles of metric design for incentive policies

The purpose of the biodiversity incentive metric is to quantify the future improvement to biodiversity arising from management changes made by landholders. In Part 1 of this report, Gorddard et al. reported that inaccuracies in the way in which a metric reflects a region's conservation values could provide perverse management incentives to land managers. To minimise these and other misleading outcomes, they developed 'The principles of metric design' for application in incentive policies.

In an unpublished draft CSIRO report on MBIs submitted to the JVAP/RIRDC in 2006 by Whitten and colleagues, nine basic principles were identified for metric design:

1. the quantity and quality of the biodiversity outcomes, i.e. whether a metric is a cardinal index or a physical quantity of a biophysical outcome
2. whether spatial relationships of proposed management changes in the landscape are important in delivering outcomes
3. whether marginal change is important, especially if the goal of a policy is to improve outcomes from a baseline, rather than pay for some absolute maximum
4. the location of the change and its impact on community values
5. how long it takes to achieve the outcomes
6. the risk/certainty of successfully implementing different management interventions
7. the risk/certainty of achieving the desired outcomes from the different management interventions
8. the irreversibility of management actions that have adverse flow-on effects on local biophysical attributes
9. spill-over impacts in the landscape, away from the site of management intervention.

Whitten et al (unpub) particularly caution that not all metric design principles will necessarily be important for all incentives and neither are the principles uniquely identifiable in components of the metric.

3.1.6 Lessons learnt in designing biodiversity incentive metrics

The Desert Knowledge CRC's 'Rewards for biodiversity' project reviewed existing biodiversity metrics for incentive policies. In this review, several design issues for biodiversity incentive metrics were identified and are summarised as (i) incentive policy design issues, (ii) metric structure issues and (iii) scoring method issues.

(i) Incentive policy design issues

Biodiversity incentive metrics are tools of an incentive policy, so policy design issues directly influence the metric design.

- Incentive policies are nested within regional biodiversity planning processes; therefore, the metric will be purpose specific depending on the biodiversity conservation priorities, and production and lifestyle values of landholders and the wider community. In addition, the environmental variability of regions will mean that the metric is context specific.
- Good metric design links the metric to the incentive policy aims. We are not aware of any frameworks for metric design that guide the designer on how to do this.
- The policy features of a metric and its limitations must be well communicated to all potential users to gain their acceptance.

(ii) Metric structure issues

As described for the BBI, information is needed on the condition of biodiversity, its vulnerability to threats and pressures, and future management outcomes. This requires not only identifying surrogates for the biodiversity values, but also that surrogates be measurable with some degree of scientific certainty (McCarthy et al. 2004). This is a difficult task, especially in the highly variable and unpredictable environments of the arid rangelands (Smyth & James 2004). Issues concerning the metric structure are as follows:

- Some practitioners have dropped the 'land use change impact' component of the BBI because of its unreliability (an example is the West 2000 Plus project initiated by the now defunct New South Wales Department of Natural Resources, Gole et al. 2005). Where this occurs, it means that the biodiversity incentive metrics measure biodiversity condition only and not improvements in biodiversity arising from management changes. This is a problem for any incentive policy where the metric is used to classify and rank competitive bids for incentives based on biodiversity improvements. In the rangelands, new approaches will be needed to predict biodiversity improvements resulting from management changes.
- The surrogates selected determine the achievement measures and, if these are unsuitable and inconsistent measures, then perverse outcomes from management are possible (Whitten et al, unpub).
- The cost and expertise required to collect biophysical information at the site level in the vast landscapes of the rangelands may prohibit the use of some credible surrogates or even delay development of the metric. For example, it may be necessary to use newly developed remote sensing tools for rangeland condition (Bastin & Ludwig 2006).
- A challenge that is proving difficult to resolve reliably is the 'second guessing' of the gains to biodiversity resulting from management change. Achievement measures that are instructive or helpful for assessors[2] and landholders in interpreting and managing sites is necessary if they are to accept the metric.
- A metric should produce information on management outcomes that supplement the regional priorities for biodiversity conservation, not just in terms of its representativeness, but also in terms of its vulnerability.
- When using 'vegetation condition' achievement measures, they should be (i) significantly associated with the biota and processes of interest, (ii) not too closely correlated with other attributes being measured, (iii) applicable over the range of ecosystems and ecosystem states under consideration, and (iv) sufficiently sensitive to discriminate between the range of sites and states under consideration.
- When working with incomplete knowledge and understanding, we learn from past actions. So information should be fed back through due process to improve metric design.

(iii) Scoring method issues

- Different types of management changes will have different effects on biodiversity, so weightings are needed to quantify their achievability by landholders and for scientific credibility (e.g. Bryan et al. 2005). For example, those management

2 Assessors visit the sites of proposed management changes of those landholders who were successful in the EOI round of applications. The information they collect is usually used as raw or derived data in the biodiversity incentive metric.

changes that can be realistically undertaken by landholders, and which have been demonstrated to have a beneficial impact on biodiversity in the short term, should receive higher weightings to increase the rank of the total score for the metric.

- In the rangelands, information that is collected at a site will need to be standardised to regional values both spatially and temporally (e.g. land types and for long dry periods respectively) to assess future biodiversity improvements at the site relative to regional priorities.

There are many design issues to consider when developing a biodiversity incentive metric. Whether these can be addressed in the design process depends on the environmental, socio-economic and cultural characteristics of the region and how well they are documented.

3.2 The conceptual framework

The interdependencies of the key factors that influence the design of a biodiversity incentive metric are conceptualised in the framework shown in Figure 11. We recognise that there are factors not considered above that could also be important, such as the issues outlined for Aboriginal lands of the spinifex deserts, as discussed in Part 3 of this report. The framework we propose here is not meant to be prescriptive. Instead, we recommend that it be used as an educative tool in a non-linear fashion to inform the design of biodiversity incentive metrics.

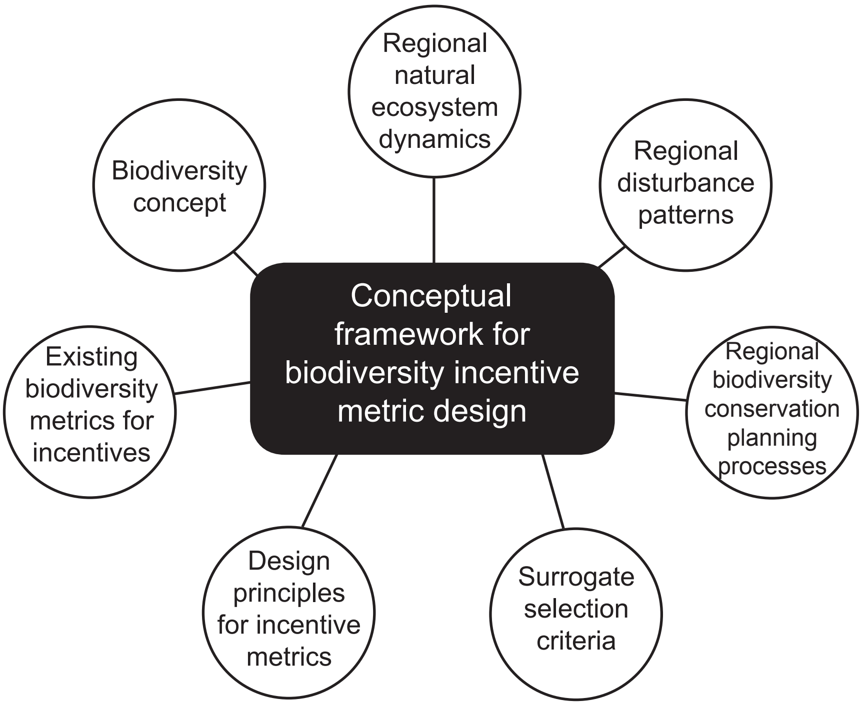

Figure 11: A conceptual framework for designing a biodiversity incentive metric

Note: For application with incentive policies in Australia's rangelands

The conceptual framework summarises the importance of having scientific knowledge of biodiversity, the ecosystem processes and the disturbances that impact the condition of biodiversity in the region of interest; a working knowledge of the regional conservation planning objectives and processes, and the role of surrogacy in biodiversity conservation; a scientific knowledge of NRM economics, values and incentive design; and a well-developed knowledge of metric design for conservation incentives. In most cases, good design of biodiversity incentive metrics will require a multidisciplinary team of experts to integrate this background information.

3.3 The operational framework

The next challenge in the design of a biodiversity incentive metric is linking the biological aspects of the metric to the relevant incentive policy. Good design at this stage is paramount as failures can be costly both financially and in terms of goodwill (Parts 1 and 4 of this report; Whitten et al, unpub). In designing an incentive policy, the design of its metric is one step in the process, building on the information gathered on market failure and policy design issues as outlined by Gorddard in Part 1 of this report. The steps in designing the metric have many similarities to those in designing policy but differ in being driven by biological expertise rather than the socio-economic issues of biodiversity conservation. Here, we describe the operational framework we developed to guide the metric design process.

We propose that there are three sequential stages in developing a metric:

1. a systematic assessment of the regional biodiversity conservation issues
2. a decision analysis of the features of the metric
3. evaluation of the metric by landholders and technical experts.

The three stages are depicted in the operational framework shown in Figure 12. Within each stage, development is not necessarily a linear process but rather a ‘learn by doing’ approach as the policy features can shift from the ideal design due to impediments in knowledge and technologies.

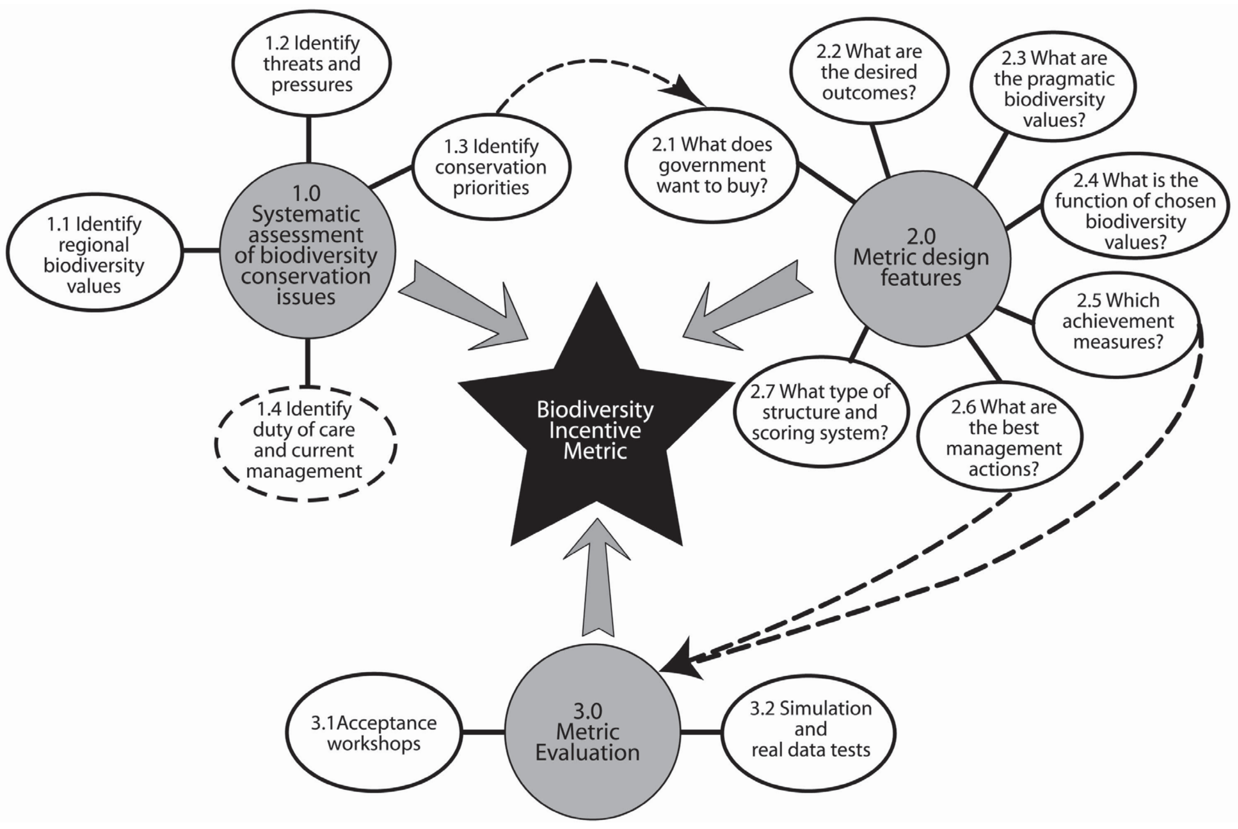

Figure 12: An operational framework for the three stages in the design of a biodiversity incentive metric

Note: the diagram shows the links among the stages and information flows of the developmental process. It is critical that the dotted path be followed in designing the policy.

3.3.1 Stage 1 – Systematically assessing regional biodiversity conservation issues

We propose that the first step is to document the regional biodiversity conservation issues relevant to the incentive policy. This requires auditing the biodiversity values and the threats and pressures on those values, and ranking the issues. Most of this information should already be documented in regional biodiversity conservation plans but more information may be required depending on the comprehensiveness of the plans. When information is not available at the regional level, a series of workshops involving government NRM agencies, biodiversity conservation planners, pastoral land assessors and landholders is needed to get an integrated understanding of the conservation issues. The information gained will be used to guide the policy and metric features. Substantial investment of resources is required for the participatory workshops.

3.3.2 Stage 2 – Analysing the features of the metric

Identifying the features of the biodiversity incentive metric is a multi-faceted process. We propose seven steps to achieve this task as shown in Figure 12. The tasks for each of these steps are described in detail in Section 4.2 where we describe how we applied this framework in the Stony Plains bioregion case study. Each step must be clearly articulated so that the appropriate achievement measures to assess future biodiversity conservation outcomes of management change are chosen, and to help design the metric structure and scoring method. A lack of clarity in any of these steps could affect the capacity of the metric to quantify management outcomes correctly. It is essential that the metric actually measures what was meant to be captured at the outset.

Stakeholders will need to specify desired conservation outcomes, biodiversity values, biodiversity surrogates and achievable management actions. Steps 2.1 to 2.3 will refine the policy features of the metric while steps 2.4 to 2.6 focus on selecting appropriate achievement measures that are surrogates of the biodiversity values for the different desired outcomes. This stage is particularly demanding of resources because it needs considerable work to transform the broad biodiversity conservation aspirations often found in regional plans into measurable attributes for quantifying management outcomes. This involves deciding what mix of attributes will be used to specify achievement measures (Parts 1 and 4 of this report). Depending on the policy aims, these could be measures of inputs (e.g. number of kangaroos harvested), processes (e.g. thresholds for rangeland condition as measured by the leakiness index, (Bastin & Ludwig 2006)) or outcomes (e.g. nominated amount of vegetation cover for a particular land type). The process for getting this information needs to be undertaken in participatory workshops and facilitated by resource economists.

3.3.3 Stage 3 – Evaluating the metric

In the final stage of the design of the biodiversity incentive metric, we propose testing the metric’s initial acceptance by stakeholders (e.g. administrators, pastoral land assessors, landholders, biodiversity conservation planners) and its credibility. This step is important as it will influence participation in incentive schemes where the metric is used as part of the selection process. If end users cannot understand the biodiversity values that need managing and how to manage them, they are less likely to become involved in a scheme (Part 4 this report). It is particularly important for administrators to accept that the metric will inform planning in the way in which it was originally intended.

A full evaluation will require interactive workshops for stakeholders and follow-up workshops after running simulations and tests on real data.

4. Design features of a biodiversity incentive metric for the Stony Plains bioregion

4.1 Introduction

In this chapter, we describe how we used the integrated approach outlined in Chapter 3, particularly the operational framework, as a 'proof of concept' for identifying the design features of an outcome-based biodiversity incentive metric for biodiversity conservation in the Stony Plains bioregion of the South Australian rangelands. For the purposes of our study, we assumed that the Government of South Australia wanted to implement an incentive policy for biodiversity outcomes in this bioregion. The purpose of the metric, therefore, was to assess the future biodiversity outcomes resulting from changes in grazing land management at sites on properties nominated by cattle producers – the major landholders in the region. In reality, there is generally governmental and public curiosity about the use of incentives for biodiversity conservation outcomes in South Australia, but, at the time of writing, we are not aware of any plans to implement such policies in the Stony Plains bioregion.

When developing NRM incentive policies and associated metrics for the first time for a region, considerable resources are required to refine the design issues beyond those already documented in regional plans. Although we had intended to apply the operational framework in its entirety, we had sufficient resources for developing only the structure of a biodiversity incentive metric. We have yet to fully develop the scoring method and undertake a comprehensive evaluation of the proposed metric as per stages 2 and 3 of the operational framework. The scoring method is necessary for calculating a cardinal index that quantifies the relative merit of proposed management changes for specific biodiversity outcomes in grazed lands, as submitted by individual cattle producers in a public call for applications for incentive allocations. The mathematics of the scoring method supports the structural features of the metric. However, without a well-designed structure, the mathematics can be misleading and produce counterproductive results. Therefore, we have spent considerable effort on designing a realistic but credible structure for the biodiversity incentive metric but, as will be seen in Chapter 5, the metric remains conceptual only.

4.2 The Stony Plains bioregion

We chose the Stony Plains bioregion as a case study because a linked research project on tools for assessing biodiversity (including tools for incentives), funded by the DKCRC, was already underway in the region and a number of scientific and regional planning resources were available.

The Stony Plains bioregion covers an area of 129 240 km^2 (13.2%) of South Australia (see Figure 13). Its key features are the vast undulating gibber and gypsum plains that can be separated into five major landforms, each supporting broadly different ecological communities:

- drainage lines and flood plains
- stony plains and tablelands
- Great Artesian Basin springs
- dunefields and sand plains
- breakaways and stony hills.

The bioregion supports 77 land types in 52 land systems, 17 major vegetation types with many floristic groups, 784 plant species, approximately 230 bird species, 100 reptiles, 41 native and 11 feral species of mammals, and five species of frogs. Apart from the birds, which are most diverse in the drainage lines, most species commonly occur in the stony plains communities of the bioregion. These communities have undulating topography with gilgai depressions, puffy clay areas, hard pans, rocky outcrops, and gibber pavements that range in size from pebbles to small boulders. The taxonomic richness of invertebrates is unknown but is likely to be high for those favouring arid environments (e.g. ants, grasshoppers, termites) and less diverse overall when compared with wetter environments. The bioregion supports 46 endemic taxa and a total of 16 threatened ecological communities, plants and animals.

SOUTH AUSTRALIAN ARID LANDS NRM REGION

Interim Biogeographic Regionalisation for Australia (IBRA) Bioregions

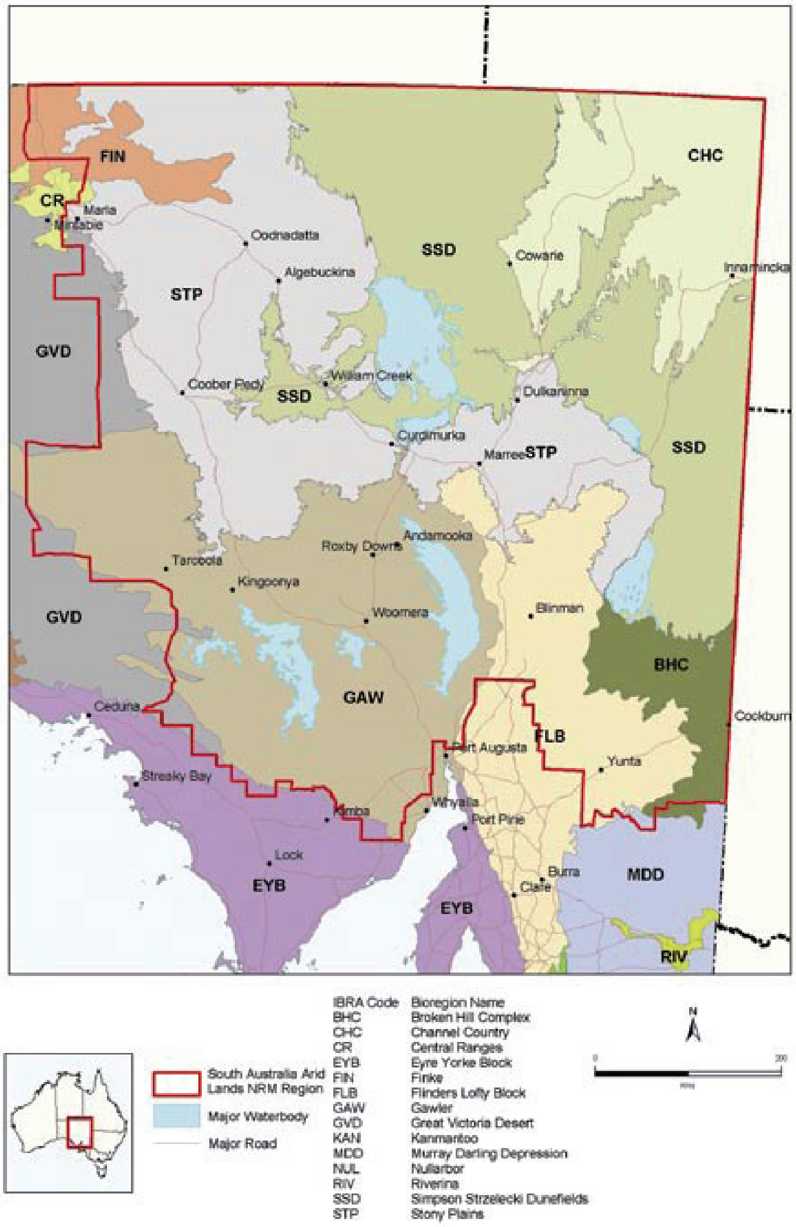

Figure 13: Bioregions of South Australia

Note: The Stony Plains (STP) are in pale grey (SADEH 2005)

Land uses are cattle grazing, mining, ecotourism, protected areas and regional towns, with cattle grazing being the most widespread, especially in the productive stony plains communities. Cattle producers, through leasehold and existing or pending Indigenous land use arrangements, are the major landholders in the bioregion. Biodiversity is important for the production, natural and cultural heritage values in the bioregion. The threats and pressures to its values are:

- loss, fragmentation and degradation of functioning ecological communities through excessive total grazing pressure exerted by domestic stock, feral herbivores (camels, donkeys, horses and rabbits) and kangaroos north of the dog fence
- species loss through increased predation by introduced predators and total grazing pressure
- changes in natural surface water flows caused by mechanical disturbances of natural water flows and/or flooding regimes of watercourses associated with grazing (e.g. building of artificial flow barriers, storage areas and dams).

4.3 Methods

We applied the proposed operational framework to develop a pilot structure of the biodiversity incentive metric by primarily carrying out the following three broad activities:

1. a systematic assessment of the biodiversity conservation issues for the Stony Plains bioregion
2. identification of the design features of the biodiversity incentive metric
3. tentative evaluation of the design features of the metric.

The systematic assessment mainly involved identifying:

1. the regional biodiversity values
2. the regional threats and pressures and recognised disturbances to biodiversity values
3. conservation priorities.

We identified the design features of the metric by following seven separate but interrelated steps, documenting:

1. the management goals of the Government of South Australian for sustaining biodiversity in the grazing lands of Stony Plains bioregion
2. the desired outcomes of biodiversity management in the grazing lands of the bioregion
3. the biodiversity values that could be realistically maintained with appropriate grazing land management by cattle producers
4. the ecological functions of the pragmatic biodiversity values of the bioregion
5. achievement measures
6. appropriate grazing land management actions
7. an appropriate metric structure, where the principles of metric design and the guidelines for surrogate selection are applied.

Steps 1–6 informed and refined structural features of the biodiversity incentives metric described in Step 7. In a real development of a biodiversity incentive metric, the scoring method would also be fully developed in Step 7, but a lack of resources prevented us from fully developing it in this project. Instead, we will present a hypothetical scoring method in the linked project, DKCRC 1.707 ‘Rewards for biodiversity’, to demonstrate the mathematics of the scoring system for the metric.

We did a preliminary evaluation of acceptance of the metric's design features with a small group of producers as an adjunct to gathering other information in workshops. Preferably, evaluating the acceptance of the metric design would involve stakeholders from other sectors participating in specialised workshops. And to complete the evaluation of the metric, its credibility should be tested using simulations and tests with real data. Extra resources are needed to complete this activity thoroughly.

4.4 Systematically assessing the biodiversity conservation issues

The design of the biodiversity incentive metric was predicated on a systematic assessment of biodiversity conservation issues for the Stony Plains. Our assessment was based on key regional planning reports and feedback from four workshops. The reports were:

- *Draft strategy for the Stony Plains bioregion* published by the Department for Environment and Heritage, South Australia (SADEH 2005)
- *An inventory of biological resources of the rangelands of South Australia* by Neagle (2003)
- *Naturelinks: Implementing the Wild Country philosophy in South Australia* by the Department for Environment and Heritage, South Australia (Anon 2003)
- *A biological survey of the stony deserts of South Australia* by Brandle (1998).

No one document provided the details necessary to identify the features of the metric, so we held a number of stakeholder and technical workshops.

The first stakeholder workshop for wildlife biologists, conservation and land planners, and selected landholders was held in Adelaide in May 2005 (see Appendix 1 for a list of participants). A second 'biodiversity goals and outcomes' workshop of selected participants (including South Australian producers) was held in Adelaide in October 2005 (see Appendix 2 for a list of participants) to help identify the biodiversity conservation issues. A third 'MBI familiarisation' workshop was held in Adelaide in March 2006 for South Australian government agencies (excluding producers) and the Queensland and New South Wales collaborators who had experience with implementing incentives (see Appendix 3 for a list of participants). The aim of this workshop was to familiarise participants with hands-on involvement in an experimental tender and to refine the biodiversity conservation issues identified in October.

We held two technical workshops for wildlife biologists, conservation planners and pastoral assessors/land planners, one in Adelaide in March 2006 (see Appendix 4 for a list of participants), and the other in Alice Springs in June 2006 (see Appendix 5 for a list of participants). These workshops were critical for identifying the key biodiversity conservation priorities and the design features of the metric.

Our assessment took 12 person-days to complete, excluding the 37-person days for getting all the workshop information. Ideally, this work would take place as part of the regional planning processes, and especially when a policy analysis is done to identify why existing instruments are not delivering regional biodiversity conservation outcomes and whether incentives are an appropriate alternative. Metric designers should be building on the outcomes of a policy analysis for incentives rather than starting from scratch. If none of the above resources were available for a region, then assessing issues would require a substantial investment in resources over several years.

We include the findings of our assessment for the Stony Plains bioregion in Appendix 6 to illustrate the type of information that needs to be extracted from regional biodiversity plans. From this work, we scoped the features of the biodiversity incentive metric.

4.5 Designing features of the biodiversity incentive metric

The detailed information we collected in the technical workshops in March and June 2006 provided us with most of the information we needed for identifying the features of the metric.

4.5.1 What does the government want to buy?

It is important to understand the biodiversity conservation outcomes that the Government of South Australia wished to contract from cattle producers in the Stony Plains to manage the region's biodiversity. In this case study, they were prepared to buy changes in grazing land management where the goal was:

- Retain or (if possible) restore the resilience of terrestrial ecological communities/habitats across land types of the Stony Plains, excluding the Great Artesian Basin springs.

The government targeted terrestrial ecological communities because they are the most extensive communities exposed to disturbance in the bioregion. Holling (1973) defined resilience as 'a measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between system variables'. In our study, resilience was a measure of the ability of ecological communities to 'bounce back' from disturbances, especially after long dry periods. Special sites such as the Great Artesian Basin mound springs required different policies and incentives to conserve their biodiversity. We recognise the importance of these sites in regional biodiversity conservation planning but resource constraints prohibited work on these in this study.

Issues of connectivity or landscape linkages are also important for the bioregion. In the grazed lands of the Stony Plains, ecological communities/habitats mostly form a continuous natural mosaic that is broken up by disturbance associated with natural and artificial water sources (e.g. natural waterholes in drainage lines, troughs, dams). At a landscape scale, this gives a 'Swiss cheese' effect where the total grazing pressure by herbivores creates gradients of grazing pressure that taper off irregularly at increasing distances from waters, depending on the local topography. For plants and animals sensitive to frequent high grazing pressure, this can lead to isolation and habitat loss and/or decline – all of which over time has the potential to reduce biodiversity, production and aesthetic values. Although the degree of connectedness of biological composition across landscapes is an important consideration for regional biodiversity conservation, we agreed that a different incentive policy (linked to this policy) would be required to achieve this goal and, so, we did not deal further with this issue in this study; however, see McCosker and Rolfe (2004) and Gole et al. (2005) for examples of incentives for landscape linkages.

Therefore, the goal defined above provided the scope for a possible incentive policy and the design features of the biodiversity incentive metric.

4.5.2 What are the desired outcomes for biodiversity?

The desired biodiversity outcomes agreed in our October 2005 stakeholder workshop and refined in our March 2006 technical workshop were:

- native vegetation typical of the Stony Plains communities retained or restored in the short and medium terms
- loss of existing complement of rare and regionally significant native species, populations and ecological communities reduced in the short and medium terms
- natural surface water flows of natural drainage lines maintained or restored

- mosaic of water-remote areas of biodiversity significance managed by producers for the Stony Plains region in the short term.

Of all the Stony Plains plants and animals, medium-sized mammals have been the group most pressured. However, in the grazed lands native vegetation cover is widely threatened by disturbance (e.g. trampling, browsing) caused by the total grazing pressure of native and non-native herbivores (SADEH 2005, Neagle 2003). The changes to native vegetation cover in some productive land types will not only affect biodiversity values through habitat loss and modification; changes in the composition and recruitment of palatable, perennial native plants will also affect the productivity of grazing lands. Feral herbivores (donkeys, camels, rabbits in some land types, horses), kangaroo densities north of the dog fence and weed invasions are added pressures for some already stressed ecological communities. The loss and change of habitat will most likely increase predation of native animals by introduced predators at some times in some places.

4.5.3 What are the key biodiversity values?

In our assessment of the biodiversity conservation issues, we identified and prioritised a number of biodiversity values to help us identify key biodiversity values for each of the desired outcomes. We interpreted biodiversity values as the significant biodiversity assets of the Stony Plains and the value placed on those assets by people of the region and society as a whole.

We prioritised key biodiversity values based on their close alignment with the bioregion's conservation priorities (see Appendix 6). This made the task of trading off biodiversity values of different sectors a manageable task. Table 9 lists the key biodiversity values for each of the desired outcomes.

4.5.4 What are the ecological functions of the biodiversity values?

Identifying the ecological functions that maintain biodiversity was an important step for linking the achievement measures (see Section 4.5.5 below) to the attributes that people value (Table 9). This approach was necessary to clarify recognisable achievement measures that had potentially widespread acceptance by producers.

The function of the biodiversity values in Section 4.5.3 was determined in the technical workshops by wildlife biologists with expertise in theoretical and field ecology. Most functions were poorly known and largely unstudied, but using our conceptual framework we identified a coarse and incomplete list of key functions for each value (see Appendix 8). Most can be broadly summarised as relating to maintaining soil structure, providing various types of habitat (e.g. breeding places, shelter and food) or domestic stock forage, or having natural and cultural heritage values. The list will evolve as new knowledge becomes available.

4.5.5 Which achievement measures?

Achievement measures are attributes that can be measured either remotely or in the field to assess management outcomes at sites. Their values are the raw data used to calculate the sub-scores in any biodiversity incentive metric but, more importantly, the attributes can communicate to end users what information is being used to assess outcomes from management changes. Therefore, it is important that they are credible and acceptable measures for assessing the desired biodiversity outcomes. Using information gained on the function of biodiversity values for each desired outcome described above in Section 4.5.4, we produced a list of candidate achievement measures (see Appendix 9).

We used four criteria to identify the most appropriate achievement measures:

- whether the measure was a true or estimator surrogate, where true surrogates have greater scientific credibility than estimators (Sakar & Margules 2002; Whitten et al. unpublished report)
- whether the measure could be GIS-derived or remotely sensed for the purposes of deriving regional layers
- whether the measure could be assessed rapidly in the field by describing the technique
- the likelihood of the measure being implemented based on its widespread acceptance.

Using these criteria, we identified an appropriate set of achievement measures for each biodiversity value of each desired outcome and indicated their likely appeal for implementation (Table 9). Note that some achievement measures, such as vegetation cover, meet multiple biodiversity values.

4.5.6 What are appropriate management actions?

It is critical to understand which management actions can reasonably be achieved by primary producers while also being ecologically appropriate. Not only does it help prioritise potential biodiversity gains, but it also helps field officers on site visits to develop a shared understanding with producers about the best management changes to apply for achieving biodiversity outcomes.

Some credible management actions have a greater chance of succeeding because they do not conflict excessively with existing grazing land management (e.g. managing weeds, culling feral herbivores). Others will not be achievable at the property level if the management extends beyond property boundaries (e.g. managing kangaroo populations). It is also possible that some management actions, even with the best of intentions, may not have any benefits for biodiversity. Therefore, the type of contract offered – that is, if it specifies management changes or achievement measures directly – can influence the gains to biodiversity and may need to be accounted for in the design of the biodiversity incentive metric. In this way, incentives will be linked to future outcomes that are achievable by adopting appropriate management changes.

The technical workshops identified potential management actions for achieving the desired outcomes. These were ranked low, medium or high based on the following criteria:

- the likelihood of primary producers being able to consistently implement the new management
- whether the action could start an ecological change that was beneficial to biodiversity, i.e. whether it had scientific credibility.

Experts with experience in pastoral assessment of the Stony Plains ranked the management actions against Criteria 1 and experienced wildlife biologists ranked the management actions against Criteria 2. The scale of the management works was also recorded for scoring purposes. Our findings are presented in detail in Appendix 10 and summarised in Table 9.

Table 9: Design features of the biodiversity conservation metric for achieving biodiversity outcomes in the Stony Plains bioregion.

The text in italics indicates these items have the highest likelihood of being credible and acceptable. The letters in brackets indicate the likelihood (L- low, M-medium, H-high). The double likelihood (e.g. L-H) listed for the management actions indicates landholder likelihood of implementation and scientific credibility of the action respectively.

	Goal: Retain or (if possible) restore the resilience of ecological communities/habitats for land types of the Stony Plains			
Desired outcomes	**1. Native vegetation typical of the Stony Plains communities retained or restored in the short and medium terms**	**2. Loss of existing complement of rare and regionally significant native species, populations and ecological communities reduced in the short and medium terms**	**3. Natural surface water flows of natural drainage lines maintained or restored**	**4. Mosaic of water-remote areas of biodiversity significance managed by producers in the short term**
Key biodiversity values	• Vegetation cover • Plant diversity • Structural complexity • Negligible numbers of rabbits, donkeys, camels, feral horses • Pre-settlement kangaroo densities	• Endemic and threatened species and communities • Species inflexible to grazing • Significant ecological communities (gypsum clay plains, stony plains with gilgais, breakaway hills, drainage lines and flood plains, arid ranges, stony tableland with sand mounds) • Pre-settlement densities of dingos • Negligible numbers of foxes and cats • Negligible introduced weeds	• Landscape function	• Interconnected tracts of functioning ecological communities
Achievement measures	• *Average % 'dry' vegetation cover[1] (H)* • *Number of persistent, palatable native perennial plant taxa[2] (H)* • *Diversity of age classes for dry-period vegetation[1] (M)* • Landscape function[3,4], *resilience*[5], leakiness score[6,7,8] (M/H) • *Cracking Index of gilgais (H-H)* • *Presence of non-native invasive weeds (H)*	• *Register of potential threats and impacts affecting conservation-related species and significant communities in property plan (H)* • Presence of dingos, cats and foxes (sightings/track counts) (L) • *Presence of non-native invasive weeds (H)* • Presence of endemic and threatened species (L) • *Regionally significant native vegetation type (H)*	• Number of artificial earthworks redirecting water flow (L) • Frequency of gully erosion and windrows on tracks per km (L)	• *% area remote from water (H)*
Potential management actions	• *Reduce stocking rates (H-H)* • *Close waters (H-H)* • *Control pests and non-native invasive weeds incl. prevention (H-H)* • Destock early before signs of degradation (M-M) • Reduce feral herbivores and kangaroos (M-M) • Sow native perennial, palatable plants (L-M) • Develop a drought plan (H-L) • Fence dams (H-M) • Control flowing bores (H-M) • Develop a day-to-day water management plan to supplement water-remote area network and implement over time (H-L) • Align new fencing with land system boundaries (L-M) • Contribute to permanent water-remote area network (L-M) • Take out a Heritage Agreement (L-H)	• *Conduct surveillance of potential threat and impacts (H-H)* • *Reduce dingo baiting (H-M)* • Cull/trap cats and foxes (L-M) • *Fence special sites (H-M)* • *Take preventative control of pests and non-native invasive weeds (H-H)*	• *Decrease artificial earthworks that redirect water flow in a way that is unnatural (H-H)* • *Grade windrows on tracks when required (H-H)*	• Develop a regional water-remote area plan and implement it (L-M) • Develop a property water point plan to supplement the regional plan (H-L) • Take out a Heritage Agreement on station (L-H) • Close down water points (L-H) • *Relocate water points (M-M)* • *Fence off waters (M-H)* • *Control feral herbivores (M –M)*

1 Dry period vegetation cover is the vegetation cover that is typical after long periods of little or no rain;

2 Native plant taxa that are detectable and identifiable after long dry periods of little or no rain (e.g. a subset of the persistent taxa listed in Appendix 11) and palatable where palatable flora are those species favoured by domestic stock and feral herbivores

3 Tongway & Hindley 2004

4 Bastin et al. 2002

5 Pickup et al. 1994

6 Ludwig et al. 2002

7 Ludwig et al. 2006

8 Ludwig et al. in press

4.5.7 Applying the principles of metric design and the guidelines for selecting surrogates

We applied the principles of metric design and the guidelines for selecting surrogates (see Sections 3.1.5 and 3.1.3 respectively) to clearly define the biodiversity incentive features of the metric. Our recommendations for applying the principles of metric design are summarised in Table 10.

When we applied the guidelines for selecting surrogates to identify the most appropriate achievement measures, it was apparent that several achievement measures were unsuitable (Table 11). This was mostly because:

- the measure's ability to predict responses to threatening process consistently with known confidence (i.e. biological and statistical power) was uncertain
- the measure's ability to operate as an integrated measure by providing a measure of gradients across ecological systems was poor or needed further research
- the measure's ability to respond to grazing pressures at multiple spatial scales and timeframes was either unknown or limited
- the measure's capacity to be measured against regional standards/benchmarks was unknown, developing or very poor (e.g. diversity of age classes of native vegetation)
- the measure's links with existing indicators being used in the grazed lands of the Stony Plains were yet to be established.
- the measure's utility under different scales of NRM management units and tenures and the ease with which they can be applied was lacking
- the measure would not facilitate community involvement.

Combining these findings, we concluded that for three of the original desired outcomes (see Table 9), it was preferable to defer changes in management temporarily from the metric, as the metric would not achieve the desired outcomes if all management changes were included in the one incentive mechanism. The reasons for this decision were:

- **Outcome 2 (threatened species/communities)**
  We cannot measure credibly the biodiversity gains to deliver this outcome other than by having a register of potential threats and impacts drawn up by producers. We recommend the best management action is to do nothing pending more research into the management actions required to conserve individual conservation-related taxa. We did not have the resources to do this in this study.
- **Outcome 3 (natural surface water flows)**
  We cannot measure biodiversity gains credibly to deliver the outcome for natural surface waters and drainage lines in the bioregion. To do so requires further studies on a technique for remotely monitoring changes in drainage lines and erosion surfaces associated with tracks. In the meantime, we recommend no management action for this outcome.
- **Outcome 4 (water-remote areas)**
  Although the achievement measure is reasonably credible, management for this outcome is best postponed until Land & Water Australia's research on water point management for biodiversity outcomes in the bioregion is completed in 2010.

Therefore, we revised the design features of our biodiversity incentive metric to have one outcome specified by two key biodiversity values and three credible achievement measures (Table 12).

Table 10: Recommendations for the design of the biodiversity incentive metric in the Stony Plains bioregion case study

Design principle	Issues	Recommendation
Quantity/Quality		Estimate biodiversity outcomes of proposed management changes in (a) % cover of ground vegetation by land type for proposed site relative to property and the region, (b) species richness of native persistent perennial plants during long dry periods by land type for proposed site relative to the probability of species occurrence for region, and (c) site conservation priority relative to region.
Spatial relationships	Spatial relationships of vegetation are influenced by rain patterns, total stock density per water point, water point distribution and past land degradation. Specifically: Vegetation cover and species richness vary depending on when, where and how much rain falls. The management actions being bought are widespread, covering hundreds of km^2 over multiple land types (e.g. average property size is approximately 4400 km^2 and some paddocks can be as large as 1000–2000 km^2). There are about 30 potential sellers in the region. Most cattle producers have a two-tiered management scale: (i) water points in a paddock and (ii) paddocks in a property. Exceptions are the pastoral companies and some family-run companies, which may have other properties in the state or the rangelands nationally.	Use RS- and GIS-derived data for some variables but where it is technically impossible to measure attributes, ignore.
Relative change	Change is being measured at the proposed site relative to the average patterns at paddock, property and regional scales by land type. Seasonal change is controlled by collecting data for long-term dry periods only.	Where possible, use cross-fence comparisons to minimise variability.
Timing		Use a steady state model with no emphasis on when improved outcomes are expected.
Risk/certainty of implementation success		Use a weighting by overall producer capacity, which is a likelihood ranking determined by pastoral assessors.
Risk/certainty of outcome success		Use a weighting by scientific credibility of management action, which is a confidence ranking by field biologists and linked to regional biodiversity conservation planning.
Irreversibility	No issues were identified although this may differ in other regions.	
Spill-over impacts	No issues were identified although this may differ in other regions.	

Note: These recommendations were modified after CSIRO's report on MBIs submitted to JVAP/RIRDC in 2006 by Whitten, Coggan, Reeson and Shelton (unpublished)

Table 11: Assessment of the most appropriate achievement measures using the guidelines for selecting surrogates

Achievement measure		Criterion													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Desired outcome 1 – Native vegetation															
1.	Number of palatable, persistent native plant taxa	✓	✓	✓	X	✓	✓	½	✓	✓	✓	✓	½	✓	✓
2.	Average % 'dry' vegetation cover by land types at paddock, property and regional levels	✓	✓	✓	✓	✓	✓	½	✓	✓	✓	✓	✓	✓	✓
3.	Diversity of age classes for dry-period vegetation	✓	X	✓	✓	✓	✓	½	X	✓	X	X	½	X	X
4.	Landscape function[1, 2]	✓	X	½	X	X	½	½	½	✓	X	X	½	X	X
5.	Resilience[3]	✓	✓	?	X	½	✓	?	½	✓	✓	✓	X	✓	X
6.	Leakiness index[4, 5, 6]	✓	✓	✓	X	½	?	?	½	✓	✓	✓	X	✓	X
7.	Cracking index of gilgais	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	✓
Desired outcome 2 – Threatened species/communities															
8.	Presence of endemic and threatened species	X	✓	✓	X	½	½	X	X	X	✓	✓	✓	X	✓
9.	Presence of regionally significant populations or ecological communities	X	✓	✓	X	½	½	X	X	X	✓	✓	✓	X	✓
10.	Presence of dingos, cats and foxes	X	✓	X	X	✓	✓	X	X	✓	X	✓	X	X	X
11.	Presence of non-native invasive weeds	✓	✓	✓	X	✓	✓	X	X	✓	X	✓	✓	X	✓
12.	Register of potential threats and impacts affecting conservation-related species and significant communities in property plan	✓	½	X	X	X	✓	X	X	?	X	X	X	X	✓
Desired outcome 3 – Natural surface water flows															
13.	Number of artificial earthworks to redirecting water flow	✓	✓	X	X	✓	✓	X	X	✓	X	X	X	?	X
14.	Number of erosion gullies and central windrows on tracks per km	✓	✓	X	X	✓	✓	X	X	✓	X	X	X	X	X
Desired outcome 4 – Water-remote areas															
15.	% area remote from water by land type	✓	✓	½	X	X	X	✓	X	✓	✓	✓	X	✓	X

✓ – mostly met, ½ – partially met, X – not met, ? – unknown

1 Tongway & and Hindley 2004
2 Bastin et al. 2002
3 Pickup et al. 1994
4 Ludwig et al. 2002
5 Ludwig et al. 2006
6 Ludwig et al. in press

Note: See Table 8 for descriptions of criteria

Table 12: Pragmatic design features for incentives in the grazed lands of the Stony Plains

Desired biodiversity outcome	Native perennial vegetation typical of the Stony Plains maintained or restored in the short and medium terms
Key biodiversity values	• Floristic diversity, structural complexity, natural recruitment • Natural vegetation cover typical of seasonal influences
Best achievement measures	• Number of palatable, persistent, native plant taxa after a long dry period • Average % vegetation cover in dry conditions for long period • Cracking index of gilgai depressions

4.6 Gaining feedback on the metric design features

We did not directly assess producers' responses to the technical aspects of the metric. We were more interested in knowing whether the producers had a shared understanding of biodiversity and an acceptance of the metric design features, and in their responses to the use of regional data layers (i.e. remotely sensed and GIS-modelled). In the workshops, we first presented the concept of biodiversity as defined in Section 3.1.1, and then described the early design features of the biodiversity metric (see Table 13). We excluded some of the design features listed in Table 9 for reasons outlined in Section 4.5.7. We originally included Desired Outcome 2 as we thought it could be incorporated into the metric, but we later excluded it as discussed above.

Although the metric design features were specific to the Stony Plains, we tested the generality of them with producers in New South Wales and Queensland during workshops run for Part 4 of this report. Responses by these producers indicated that the features were well understood and that they closely aligned with producers' perceptions of biodiversity values. Both groups formally assessed the methods of assessment, and producers were highly supportive of a metric that used site visits and GIS/RS-derived data together but not separately (see Part 4 of this report, Section 3.5).

We did not do the same in South Australia because we were more interested in seeking feedback on a hypothetical tender to gauge producers' interest in and response to an MBI. Most of the discussion in the South Australia workshop focussed on the value of market-based incentives in the region for conserving biodiversity. There was a shared understanding of biodiversity values and discussion about appropriate management changes relevant for the region, but little about the details of the metric's design features.

Table 13: Trial design features of the biodiversity incentive metric, used to assess likely acceptance

	Goal: Retain or (if possible) restore the resilience and connectedness of ecological communities/ habitats across land types of the Stony Plains	
Desired outcomes	Native perennial vegetation typical of the Stony Plains maintained or restored in the short and medium terms	• Loss of existing complement of rare and regionally significant native species, populations and ecological communities reduced in the short and medium terms
Biodiversity values	• Plant diversity	• Threatened species and communities
Achievement measures	• Number of palatable, persistent native plant taxa after a long dry period • Diversity of age classes for dry-period vegetation	• Register of potential threats and impacts affecting conservation-related species in property plan • Increased density of dingos
Management actions	• Reduce stocking rates • Close waters • Control pests and non-native invasive weeds, including prevention	• Conduct surveillance of potential threats and impacts • Reduce dingo baiting

5. A pilot structural framework for the Stony Plains biodiversity incentive metric

5.1 Introduction

In this chapter we introduce a pilot structural framework for a biodiversity incentive metric to be applied in the Stony Plains bioregion using the design features identified in Chapter 4 as a 'proof of concept' of the integrated approach outlined in Chapter 3. Our proposed metric structure was influenced conceptually by the work of Bryan et al. (2005) who designed a similar metric for an auction on biodiversity and water quality benefits in the Onkaparinga Catchment in South Australia. They used a risk analysis framework, which is reflected in the site vulnerability component of our metric.

The Stony Plains biodiversity incentive metric is a cardinal metric that quantifies the relative merit of proposed (or past) management changes for retaining or restoring native vegetation/habitat as submitted by individual producers in a call for applications for incentives. The metric uses native vegetation as a surrogate for biodiversity values. It is designed not to link to any particular incentive mechanism (e.g. auctions, cap and trade, offsets, devolved grants). Instead, we provide a structure that can be used for incentives that require any of the following:

- quantification and comparison of the merit of proposals in a competitive call where the client is buying management changes for biodiversity conservation outcomes from primary producers
- assessments of sites proposed for management or where management has occurred and incentives are sought as a result.

If the buyer wishes to award incentives to applicants on a 'first come, first served' basis, or as a motivator to build community capacity irrespective of the relative contribution of the proposed actions to conservation outcomes, then this metric will not be required.

In this report, we refer to the Stony Plains biodiversity incentive metric as the 'BioRewards-Pilot'. We do this to reflect its conceptual nature and to highlight the way in which incentives are being used increasingly in biodiversity conservation – to reward producers for their investment in management practices and changes that are beneficial to maintaining native biodiversity.

5.2 The structure of BioRewards-Pilot

BioRewards-Pilot is an outcome-based metric with a structural framework based on three properties as shown in Figure 14:

- vulnerability of biodiversity
- results that producers can achieve through changed management
- extent of management change.

It measures the likely gain in sustaining or restoring native vegetation at a site proposed for management change.

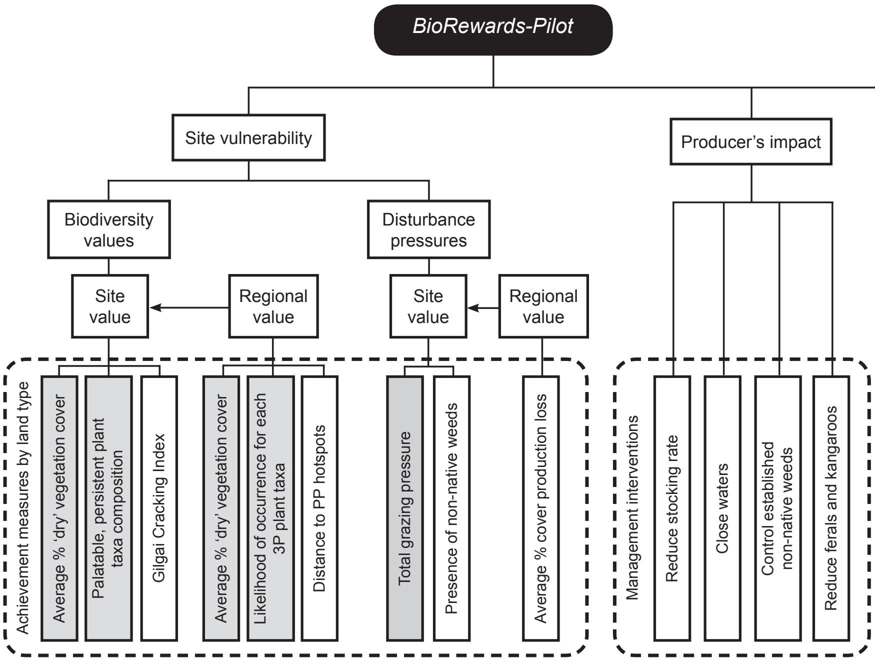

Figure 14: Structure of BioRewards-Pilot

Note: This is, a biodiversity incentive metric for retaining or restoring native vegetation/habitat in the Stony Plains bioregion, where vegetation is used as a surrogate for biodiversity values (see Table 12).

Non-generic achievement measures are shaded grey.

'Dry vegetation cover' refers to that which occurs during dry conditions where 'dry' is determined by the cumulative sum of deviations from the mean (CUSUM) analysis of rainfall (Kerle et al. in press).

PP – palatable, persistent native plant taxa

Gilgai cracking index is proposed as a generic index that assesses the cracking pattern of soil in gilgais (A. Fisher, personal communication).

5.2.1 Vulnerability of biodiversity

The vulnerability component of the metric resembles the risk analysis framework of Bryan et al. (2005). Vulnerability in conservation planning is described by three properties – exposure, intensity and impact (Wilson et al. 2005). In our case study, impact on vegetation is influenced by the intensity of total grazing pressure (i.e. the number of stock reliant on water sources). Exposure is mostly driven by the distribution and permanence of natural and artificial 'permanent' water points where 'permanent' artificial waters may last 6–36 months after rain. Unpredictable exposure of vegetation to herbivores in unwatered parts of the landscape also occurs in the paths of storm cells, where rain fills depressions for a short period (i.e. two months in cooler months, as in the gilgais of the Stony Plains communities). This type of impact, while intense, is brief, and preliminary observations suggest it does not have much effect.

BioRewards-Pilot assesses vulnerability of biodiversity by calculating a score for 'Site vulnerability' of native vegetation where a site is defined as the location proposed by the producer for the future change in management (e.g. the grazed area associated with one or a few artificial water points, areas of weed invasion, sections of creeks or a paddock). Two standardised sub-scores for 'Biodiversity values' and 'Disturbance pressures' measure site vulnerability. They are measured using achievement measures stratified by land types that are generic (comparable among sites) or non-generic (site-specific) for all sites. Non-generic site values are standardised by similar regional values to maintain comparability among sites and identify the importance of sites in a regional biodiversity planning context. A site could be important because it contains the best representation of the vegetation community for a specific land type or because the vegetation community is an example of a near-natural state for the land type or the whole bioregion. Data for site values are collected at the site whereas data for regional values are derived from modelled regional GIS/RS layers.

When assessing the vulnerability of biodiversity at a site for the allocation of incentives, it is important to standardise site-based biological information to a ‘norm’ for the region. Many incentive schemes use a site-based approach in Australia, mainly because policy development is still in its infancy. In the long term, however, continuing the site-based approach will promote a haphazard approach to regional biodiversity conservation planning and may be costly and counterproductive (Parts 1 and 4 of this report). To avoid this problem, BioRewards-Pilot has a metric structure that requires the scoring method to standardise biological and disturbance pressures to a regional ‘norm’. This is achieved through modelling of regional GIS/RS layers of achievement measures as described below.

(i) Biodiversity values sub-score

The sub-score for ‘Biodiversity values’ is calculated by site and regional values of achievement measures stratified by land type. The contribution of a site towards regional biodiversity planning is measured at the site of proposed management change (e.g. as part of a biological survey or pastoral assessment). We propose that non-generic measures be standardised to regional values using a desktop analysis of regional GIS/RS layers of the same measures. Raw values could be used for generic measures.

Site values

Field assessors will collect data on three achievement measures at proposed sites:

- % cover of vegetation during ‘dry’ conditions, by land type
- number and composition of palatable, persistent native plant species by land type (e.g. a subset of the persistent native species listed in Appendix 11) standardised to the regional value for palatable, persistent native plant taxa
- Gilgai cracking index which indicates how well gilgai depressions are functioning in the landscape.

We propose that these achievement measures be assessed during times when conditions have been dry for a long period. A cumulative summation of deviations from the mean (CUSUM) analysis of rainfall could be done to identify ‘dry’ conditions (Kerle et al. in press). We have focussed on dry conditions because it is during these times that plants are prone to environmental stress. However, producers wishing to participate in an incentive scheme may not be able to because the site proposed for management change may not be in dry conditions. We do not address this issue in our study but a well-designed scoring method could take into account a retrospective analysis using remotely-sensed data, providing that it was credible.

The percent cover of vegetation by land type during dry conditions will be estimated using standard rapid assessment techniques for biological surveys at the site. Being a non-generic measure, we suggest it be benchmarked to a regional value of cover expected for the same land type.

Although species richness of all native plants contributes to biodiversity as a whole, we are interested in tracking biodiversity gains resulting from management changes in total grazing pressure. So, we are particularly interested in observing gains in the occurrence of those native plant species that are readily observable in an arid region at all times of the year, independent of rainfall patterns, and that are also the preferred forage of domestic stock and feral herbivores. This should include native species that are palatable to stock and persistent after long dry periods. We call them 'PP native plant species'. The persistent native species were chosen by an expert panel on the arid vegetation of South Australia, from the State Herbarium of South Australia, South Australia's Department for Environment and Heritage, South Australia's Department of Water, Land and Biodiversity Conservation, and CSIRO at Alice Springs (see Appendix 11). Palatable species will be a subset of these. Pastoral assessors and cattle producers could identify these during the site assessment. These data are site-specific so we suggest they be standardised to regional values.

We omitted annual plant species because their ephemeral nature makes them unsuitable for consistently assessing management changes in arid environments. Nevertheless, we recognise that they are an important component of biodiversity in the Stony Plains and recommend that different incentives be examined for their conservation.

Gilgais are important productive ecological systems favoured by all herbivores in the stony deserts. The gilgai cracking index is a generic index that assesses functionality. It builds on the cracking index that Alaric Fisher of the Northern Territory Department of Natural Resources, Environment and The Arts has developed for gilgais in the Barkly Tablelands and elsewhere (Fisher, unpublished data). It has considerable promise but its credibility is yet to be established. Research is being done in the Stony Plains, under a Land & Water Australia research project, to test its transferability to the stony deserts. This work is expected to complete in 2009. Because these data are generic among sites, they do not need to be standardised.

Regional values

Regional values are used to calibrate the values of site-specific achievement measures observed at sites to regional benchmarks. This allows us to compare the uniqueness and importance of gains in biodiversity conservation outcomes at sites to regional patterns. Regional values are calculated for 'dry' vegetation and the PP plant species measures to calibrate their site values, and for an extra measure called 'PP plant hotspots'. This latter measure is used to assess the connectedness of the biodiversity conservation outcomes across the landscape.

The approaches that we propose for deriving these values all involve extrapolation from modelled biological survey and spatial environmental datasets. Some of the latter rely on remotely-sensed data of vegetation, elevation and topsoil patterns (i.e. radiometrics). These approaches are being used elsewhere in Australia and worldwide, (see references in Elith et al. 2006; Ferrier et al. 2004) but their application in Australia's rangelands as tools for managing biodiversity is well behind, despite the rangelands leading the nation in using spatial tools for assessing condition (see Ludwig, Bastin, Chewings and Pickup in Smyth & James 2004; Bastin & Ludwig 2006). Biological surveys are important tools for regional biodiversity conservation planning but they under-represent biodiversity patterns regionally (i.e. less than 1% of a region is sampled). Even so, they are commonly used to extrapolate regional patterns of biodiversity. Increasingly, GIS and RS tools are supporting bioregional assessment and planning worldwide, and in other parts of Australia (e.g. Australian Collaborative Rangelands Information Systems Project). Predictive modelling techniques, as described below, do not provide a perfect planning environment but when used in combination with biological survey, environmental and other data monitored over time, they can help to minimise planning errors. Some exciting developmental work using predictive modelling approaches is occurring in the rangelands as funds become available, and predictive modelling appears to offer great promise as a regional calibration tool for site-based biological information. However, its credibility and acceptance remain to be investigated.

1. Average % ‘dry’ vegetation cover by land type

This measure could be derived using MODIS imagery benchmarked to show cover relative to paddock, property and the region. It builds on the tools developed by CSIRO and SADWLBC for Land Water & Wool (Bastin et al. 2006) to test whether MODIS satellite imagery could help South Australian wool producers manage their vegetation. MODIS imagery is free of charge but it needs GIS/RS professionals with expertise in spatial analysis techniques to make it user friendly. The following tools have already been developed to the concept stage and could be further developed for BioRewards-Pilot:

- Maps of cover at nominated times for a paddock/property scaled between the historically lowest and highest values of cover for the paddock of interest, the property or region.

  The first two display types should maximise the information content for individual managers while the third option is more useful for showing how management of cover on a property is tracking relative to the region (i.e. a form of regional benchmarking). It has limitations in that regional comparisons need to take account of rainfall variation and may also be affected by landscape variation within mapped regional land types. (Bastin et al. 2006)

- Time traces of average cover across land types within paddocks can be derived from maps of vegetation cover. These traces can be used as a continuous record for the duration of the MODIS imagery, as a year-by-year or any other time record, providing adjustments are made to resolve some technical problems in producing consistent, reliable estimates of cover (Bastin et al. 2006). A subset of these traces could be produced for ‘dry’ times.

The credibility and acceptance of these tools by government agencies and participating producers in the Stony Plains bioregion are unknown and need to be evaluated. For example, some producers are suggesting appropriate cross-fence comparisons within land types are needed to interpret the tools. However, the pilot tools appear to hold some promise for BioRewards-Pilot.

2. Expected PP native plant species richness

This measure builds on the conceptual work under development by Simon Ferrier and colleagues at the New South Wales Department of Environment and Climate Change (formerly Department of Environment and Conservation) and Elith et al. (2006). It has potential for modelling taxa richness at the regional scale provided that biological survey and remotely-sensed environmental data are available. The product would be a continuous predicted spatial layer of taxa richness, which could be averaged by land types within paddocks.

We propose generating maps of the regional likelihood of occurrence for each taxon by land type based on its presence/absence at all the sites recorded in biological survey and pastoral monitoring databases. Many modelling methods allow spatial modelling of species distributions using environmental predictors, but general dissimilarity modelling for single species (GDM-SS) is preferred as it incorporates non-linear responses to environmental data – a phenomena common in ecological data (Elith et al. 2006). GDM models the spatial turnover in community composition between pairs of sites as a function of environmental differences between sites. An extra kernel regression algorithm is applied to estimate the likelihood of a species occurring at all sites (e.g. Elith et al. 2006, Ferrier et al. 2004). This information could be used to assess the uniqueness of species composition at a site relative to predicted regional distributions.

This is the only approach that appears to offer promise for standardising the taxa richness of proposed sites in the rangelands for a metric. However, unlike in New South Wales, the concept has not been developed for the Stony Plains. We expect it could be successfully applied but considerable research is needed to test its credibility for standardising the taxa richness of sites. Further work includes simulation testing and ground-truthing the real data and trialling its acceptance with producers and governments before it could be applied in BioRewards-Pilot.

3. PP regional hotspots

The measure of biodiversity hotspots within a land type is derived from a model of places that have a unique complement of existing PP plant richness. By calculating the average distance of the proposed sites from the modelled hotspots, it should be possible to gauge the degree of connectivity of PP plants at the proposed sites to those predicted elsewhere in the landscape. The value of a proposed site relative to neighbouring hotspots can be assessed for its contribution towards landscape connectivity. The higher the average distance the proposed site is to a hotspot, the greater its value towards maintaining landscape connectivity. General dissimilarity modelling can be used to model the compositional dissimilarity in PP plant species between pairs of sites as a function of environmental differences between these sites, as described by Ferrier (2002) and Ferrier et al. (2002). The output is a map of predicted PP flora by land type for a region within which biodiversity hotspots can be identified using complementarity approaches (e.g. ED Manual), Faith & Walker 1996). These approaches have credibility and have been used to inform biodiversity conservation planning in some parts of New South Wales for the past 10 years. Similar developmental research has been applied in the arid rangelands south of Alice Springs to identify priority places (see Figure 15 for an example); it appears to offer promise although the research on its credibility and its acceptance has yet to be undertaken in the Stony Plains.

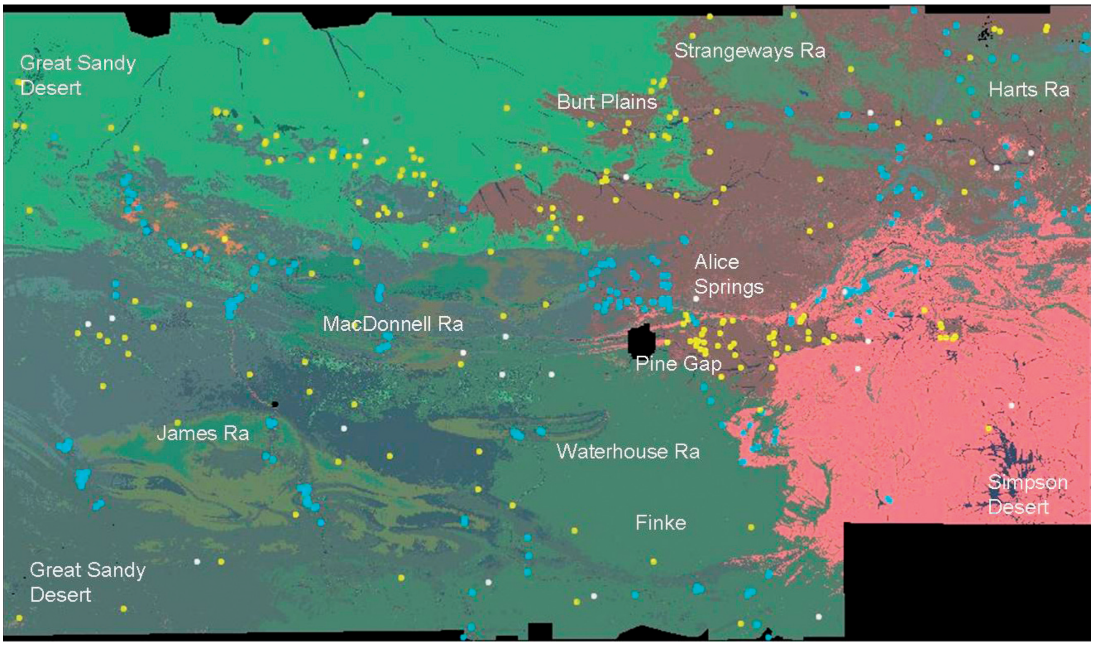

Figure 15: Example of a pilot predictive map of spatial turnover of plant diversity near Alice Springs.

Note: the map shows priority places for monitoring biodiversity (yellow) extrapolated from existing biological survey sites (blue). Priority places were determined by applying the 'ED' technique to a vulnerability coverage (Smyth et al. unpublished data). The black areas are where spatial information is not available for modelling.

(ii) Disturbance pressures sub-score

The disturbance pressures sub-score is a measure of the intensity of the impact of, and exposure to, disturbances that affect the outcomes of native vegetation management in the Stony Plains. It also incorporates an analysis of the risks to native vegetation which influence management outcomes. As we identified in our assessment of the biodiversity conservation issues for the Stony Plains, total grazing pressure is the most widespread pressure affecting native vegetation (Brandle 1998, Neagle 2003). Non-native invasive weeds are a lesser pressure, but buffel grass (*Cenchrus ciliaris*) has the potential to colonise many drainage channels in the region. Buffel grass is widespread in the rangelands (Friedel et al. 2006) and it already occurs in small areas of the Stony Plains bioregion along a few drainage lines, roadsides and the railway line.

Site values

The level of disturbance affecting a site is measured by a field assessment of total grazing pressure and presence of invasive non-native weeds.

1. Total grazing pressure

Total grazing pressure can be based on information already obtained by pastoral assessors when assessing leases and on extra site information gained from the producer during the field assessment. For the Stony Plains, we used:

- number of domestic and feral stock[3], rabbits and kangaroos on the waters of the site
- historical numbers of domestic and feral stock, rabbits and kangaroos on the waters of the site
- preferred grazing locations, for most of the time or at particular times on the site, marked on a map
- productive value of areas within the site, marked on a map
- age of all permanent waters on site where permanency is greater than 12 months.

From this information, it is possible to estimate current stocking density, the intensity of grazing, and how long the preferred grazing areas of the proposed site have been exposed to grazing. However, this information is site-specific and will differ among land types and so it will need to be standardised to regional benchmarks. It could also be supported by feral animal survey information.

2. Presence of invasive non-native weed species

This achievement measure is a binary value (yes/no) that is generic among sites. We propose it be used to weight vegetation measures where an absence of highly invasive non-native weeds should increase the overall site value. A technical panel of regional weed experts, pastoral assessors and producers should be used to identify highly invasive non-native weeds using the latest revision by Grice and Martin (2005, Table 2.2).

Regional values

The level of disturbance pressure associated with total grazing pressure is difficult to assess regionally, but exciting developmental products using remotely-sensed data have been proposed by Pickup and Chewings (1994) and Pickup and Bastin (1997). Another way to think about the problem of standardising the site-specific information on grazing pressure is to standardise the site values by land degradation benchmarks. Bastin and colleagues at CSIRO have conceptualised a

3 The main feral stock are camels, horses and donkeys.

spatial statistical model of declining grazing by cattle from a water point specific to each grid cell for each land type, to derive a 'percent cover production loss' (%CPL). The derivation of this value relies on remotely-sensed data for grazing gradients in dry and wet periods within the same land types. The method is developmental and approximate, and makes several assumptions:

- Cattle (and other herbivores dependent on water) preferentially graze land types with more nutritious and palatable vegetation, particularly that which provides greater energy and protein. These land types are generally correlated with land systems that have higher soil fertility. They may also receive extra water from rainfall through redistribution (run-off and run-on).
- Grazing is concentrated around water points and decreases linearly with increasing distance from water as cattle are forced to forage further from water in search of attractive pasture – generally, more nutritious (energy-rich) and palatable forage, particularly fresher 'green pick'.
- The greater nutritional value (particularly energy) of herbage species growing on land types (or land systems) with fertile soil allows cattle to forage further from water. These land systems have both higher grazing capacity (translating to actual stocking rates) and greater grazing impact with increased distance from water.
- Conversely, the reduced palatability and nutritional value (particularly energy) of poorer quality forage growing on infertile soils does not allow cattle to graze as far from water. These land systems have both lower grazing capacity and reduced grazing impact with increased distance from water.

The assumption that total grazing pressure declines with distance from water as inherent grazing value declines is supported by the grazing gradient results for central Australia (Bastin et al. 1993). The more productive land systems have more persistent grazing gradients extending further from water (i.e. higher %CPL values inferring greater land degradation or disturbance pressure). The distances to which %CPL values can be derived are used to guide the assignment of grazing distances. However, setting grazing capacity values is a highly arbitrary business. Therefore, the expert opinion of producers and pastoral assessors on the relative productivity of different land types needs to be first sought. It is not so much the actual grazing capacity assigned but the relative grazing value (and impact with distance from water) among land types that is critical information.

This is the only approach that appears to offer promise for standardising the site-specific information on total grazing pressure. It is important to have an independent measure of disturbance pressure that may affect management outcomes, as it could minimise any perverse behaviour concerning site-based stocking densities and management practices, should such behaviour occur. This concept has been roughly applied in the Stony Plains and, although it is developmental, it could be modified for use in BioRewards-Pilot once its credibility and acceptability are established with producers and government administrators. Further work is needed to calibrate these results for nominated areas with reference sites or by the use of cross-fence comparisons in the same land type. Given that derivation of the %CPL relies on wet years, having enough wet years could be a problem.

5.2.2 Producer's impact

This property of the metric quantifies the future success that a producer's change in management may have on the site biodiversity values as measured by native vegetation. Management success is assessed by the capacity of the producer to use different types of management and by scientific credibility of the management action in reducing disturbance pressures on the biodiversity values.

In Table 9 we identified the rating for the ‘capacity’ and ‘credibility’ criteria for appropriate management actions to retain or restore native vegetation (i.e. Desired Outcome 1) using the double likelihood combination of low, medium and high, based on an assessment by an expert panel with expertise in the region (see Appendix 5) and comments from John Read of BHP Billiton and Gary Bastin of CSIRO. Using these data, we assigned a likelihood weighting of 2, 4 or 6 for each of the two criteria for each management action (Table 14). Given that this information interactively affects the success of management actions, we suggest multiplying the two pieces of information (capacity rating and credibility rating) to derive the weights, as recommended by Gibbons and Freudenberger (2006). Weightings of this type involve trade-offs in values so we recommend that producers, pastoral assessors and biologists are consulted. As shown in Table 14, the ‘Producer impact weight’ moderates the site vulnerability score by using weights for each of the management actions.

Table 14: Producer impact weights based on an expert panel’s assessment.

Potential management action	Producer capacity rating (Low = 2 Moderate = 4 High = 6)	Scientific credibility rating Low = 2 Medium = 4 High= 6	Producer impact weight
Reduce stocking rate appropriate for land type	6	6	36
Close waters	6	6	36
Control non-native weeds post-establishment	6	6	36
Reduce feral herbivores and kangaroos	6	4	24
Control flowing bores	6	3	18
Destock early before signs of degradation	4	4	16
Fence dams	5	3	15
Develop drought plan	6	2	12
Take out a Heritage Agreement	2	6	12
Align new fencing with land system boundaries	2	4	8
Sow native perennial, palatable plants	2	4	8
Contribute to water-remote network	2	4	8
Develop water management plan to supplement water-remote area network and implement over time	6	2	6

Note: The larger the PIW value, the more likely it is that the potential management action will achieve the desired biodiversity conservation outcome(s).

(See Appendixes 4 and 5)

5.2.3 Area of management works

The size of the management works beneficial to biodiversity is calculated using spatial analytical techniques so that the cost-effectiveness of the proposed management changes per cattle producer can be assessed.

5.2.4 Summary

BioRewards-Pilot is an outcomes-based biodiversity incentive metric for retaining and restoring native vegetation and habitat in the grazed lands of the Stony Plains bioregion, where vegetation is used as a surrogate for biodiversity values. The vulnerability of native vegetation, the impact of the producer’s proposed management and the area of management works are the core parameters of the metric. Gains in resilience of native vegetation in the region are assessed for each site by calculating a score for site vulnerability of native vegetation. This score is then weighted by a score representing the producer's impact (i.e. the differential outcomes of the producer's management) and the area of management works. Vulnerability is assessed by the significance of biodiversity values and the impact of disturbance pressures. These variables are measured by achievement measures that are generic or non-generic (site-specific) among sites. Non-generic site values are standardised by similar regional values to maintain comparability among sites and identify the importance of sites in a regional context. We propose that all regional values be derived from continuous remotely-sensed or GIS layers of the achievement measures for the whole Stony Plains bioregion. However, we stress that the structure of the metric is at the conceptual stage of development. Considerable developmental and evaluation work, and resources, are required before the regional values can be implemented in the metric.

6. Conclusions and recommendations

The most challenging aspects of designing the structure of BioRewards-Pilot was identifying an approach that incorporated the principles of metric design for incentive policies, that quantified the future management outcomes for biodiversity at sites in a regional context that aligned with regional biodiversity conservation planning objectives, and that could be applied with any incentive instrument. We developed a conceptual framework and an operational framework where the former conceptualises the key factors that influence the design of a biodiversity incentive metric and the latter guides developers in designing the metric for application in any incentive policy, whether market or non-market-based. These two frameworks underpin an integrated approach that we propose for the design of biodiversity incentive metrics for Australia's rangelands.

We applied the integrated approach to identify the design features and develop the structural framework of the metric so that it was a regional rather than site-based metric (i.e. standardising site-specific values of sites so that the gains in biodiversity outcomes could be assessed in a regional context). This involved developing a metric structure that drew on developmental work for spatially modelling vegetation and biodiversity attributes from which regional values can be derived to standardise site values. These novel tools appear to have exciting potential but their scientific credibility and acceptance by stakeholders remains to be fully studied before we know the extent to which they can be applied in BioRewards-Pilot. We did not have the capacity and time to address credibility and acceptance in this project but we believe it is an important area of research for BioRewards-Pilot or any such research to be applied in the rangelands. An evaluation of this kind is needed to minimise perverse actions and outcomes resulting from applying metrics, and to build on the preliminary acceptance by producers of the use of site-based and remotely-sensed data in assessments. The technical issues of refining the regional data layers are less of a problem as most methods are well documented and could be applied by GIS professionals in government agencies. A solution would be to resource research scientists and government spatial analysts to work together on projects to refine and evaluate these products for implementation.

Identifying the metric design features was the most challenging activity in this project as there was a tendency by participants to list all possible desired outcomes for conserving biodiversity values. Often the desired outcomes and biodiversity values were non-specific and aspirational. There was also an expectation that one incentive policy could address all the desired outcomes, which may be theoretically possible but, based on the experience of designers of other incentive policies, would have been too complicated to apply and communicate to producers and administrators, as discussed in our workshops. Considerable facilitation involving trade-offs in values and outcomes was needed to extract a realistic set of achievement measures that could be applied in a biodiversity incentive metric. When we recognised that we would need multiple incentive instruments to deliver multiple desired outcomes (e.g. threatened species conservation), we had to tailor the metric design to a single desired outcome. Gaps in knowledge about the ecology of some biodiversity attributes also meant that some aspects of the design features were less well developed (e.g. identifying the ecological function of biodiversity values and applying the criteria for selecting surrogates). Because metrics summarise complex information into a single value and can easily send misleading signals, it is critically important that the baseline ecology of biological knowledge be well understood.

We are disappointed that we did not fully develop a scoring method; however, using the structure outlined in this report, the task should be straightforward.

Our findings and recommendations for developing a biodiversity incentive metric for the rangelands are as follows:

1. Clearly define the purpose of all biodiversity metrics so that communicating their roles with end users is easier.
2. Design biodiversity incentive metrics concurrently with the incentive policy and other regional conservation planning processes.
3. When developing biodiversity incentive metrics for Australia's rangelands, use an integrated approach that links conceptual and operational frameworks as proposed in this document.
4. Make sure resources are available to refine the design issues beyond those already documented in regional plans and to run interdisciplinary workshops.
5. When designing biodiversity incentive metrics, consider the principles of metric design for incentive policies.
6. When choosing achievement measures, make sure they reflect the ecological function of the attributes representing the regional biodiversity values. To increase their scientific credibility, use the guidelines for selecting surrogates.
7. To increase acceptance by producers of a biodiversity incentive metric, use a combination of field-based and remotely derived data for achievement measures.
8. Design incentive policies and their metrics so that they are readily understood by producers and administrators. Where possible, use multiple incentives and metrics rather than a 'one size fits all' approach.
9. Include regional level achievement measures in the metric structure for use as regional benchmarks.
10. Invest in calibrating and further developing surrogate spatial datasets for bioregions as described for BioRewards-Pilot.
11. Invest in formally accepting and assessing the scientific credibility of the structure of BioRewards-Pilot before refining it any further.

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Appendix 1: Participants of stakeholder workshop, May 2005

Participants	Affiliation
Anita Smyth	CSIRO, Alice Springs
John Chappel	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Ken Clark	The University of Adelaide
Megan Lewis	The University of Adelaide
John Maconochie	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Amanda Brook	Knowledge Information, Department of Water, Land and Biodiversity Conservation, South Australia
Mike Fleming	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Robert Brandle	Biological Survey and Research, Department for Environment and Heritage, South Australia
Vanessa Chewings	CSIRO, Alice Springs
John Read	BHP Billiton, Olympic Dam
Anthony Freebairn	Department for Environment and Heritage, South Australia
Charlie Jackson	Aboriginal Arid Lands NRM
Dionne Walsh	Centralian Land Management Association
Sharron Oldfield	Cowarie Station, South Australia
Michael McBride	McBride Pastoral Company and Pastoral Board of South Australia
Greg Campbell	S. Kidman & Co.

Appendix 2: Participants of biodiversity outcomes workshop, October 2005

Participants	Affiliation
Anita Smyth	CSIRO, Alice Springs
John Chappel	Pastoral Board, South Australia
Amanda Brook	Knowledge Information, Department of Water, Land and Biodiversity Conservation, South Australia
Robert Brandle	Biological Survey and Research, Department for Environment and Heritage, South Australia
John Read	BHP Billiton, Olympic Dam
Anthony Freebairn	Department for Environment and Heritage, South Australia
John Gavin	SA Arid Lands NRM Board
Geoff Mills	Producer
Phil Cullen	Producer
Paul Jupp	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Mike Fleming	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Stuart Whitten	CSIRO
Anthea Coggan	CSIRO
Jocelyn Davies	CSIRO
Jo Maloney	Tangentyere Land Council, Alice Springs

Appendix 3: Participants of MBI familiarisation workshop, March 2006

Participants	Affiliation
Anita Smyth	CSIRO, Alice Springs
Craig Walker	Knowledge Information, Department of Water, Land and Biodiversity Conservation, South Australia
Peter Bulter	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Vick Linton	MBIs, Department for Environment and Heritage, South Australia
Renee Shepherd	Department of Environment & Climate Change, NSW
Amanda Brook	Knowledge Information, Department of Water, Land and Biodiversity Conservation, South Australia
Mike Fleming	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Robert Brandle	Biological Survey and Research, Department for Environment and Heritage, South Australia
Russell Gorddard	CSIRO
John Read	BHP Billiton, Olympic Dam
Anthony Freebairn	Department for Environment and Heritage, South Australia
Rick Davies	CSIRO
Stuart Whitten	CSIRO
Lyn Pullen	Queensland Murray-Darling Basin Commission
John Gavin	SA Arid Lands NRM Board
John Lumb	Australian Government Department of the Environment and Water Resources

Appendix 4: Participants of technical workshop, March 2006

Participants	Affiliation
Anita Smyth	CSIRO, Alice Springs
Amanda Brook	Knowledge Information, Department of Water, Land and Biodiversity Conservation, South Australia
Mike Fleming	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Robert Brandle	Biological Survey and Research, Department for Environment and Heritage, South Australia
Russell Gorddard	CSIRO
John Read	BHP Billiton, Olympic Dam
Rick Davies	CSIRO
Stuart Whitten	CSIRO

Appendix 5: Participants of technical workshop, March 2006

Participants	Affiliation
Anita Smyth	CSIRO, Alice Springs
Mike Fleming	Pastoral Program, Department of Water, Land and Biodiversity Conservation, South Australia
Robert Brandle	Biological Survey and Research, Department for Environment and Heritage, South Australia

Appendix 6: Systematic assessment of biodiversity conservation issues for the Stony Plains Bioregion

In this appendix, we identify the terrestrial biodiversity conservation priorities associated with total grazing pressure (TGP), we consider who is responsible for managing them, and we describe current duty of care instruments. We focussed on TGP because it is the most widespread and significant disturbance that is pressuring terrestrial biodiversity of the Stony Plains bioregion (SADEH 2005). But first, we briefly summarise the key biodiversity assets and the biodiversity values of the region, and the threats and pressures affecting them.

1. Biodiversity assets and values

The key biodiversity values that influenced the design of the biodiversity incentive metric, and that were based on the assets of the region described in Section 4.2, are listed in Box 4.

2. Threats and pressures

Threats and pressures on biodiversity are many in the Stony Plains region. Some are specific to particular land types of the region, some occur only in the Stony Plains, and some are statewide. Many threats and pressures are recognised in the Draft Biodiversity Strategy for the Stony Plains bioregion (SADEH 2005).

Of these, excessive TGP and related mechanical disturbances are recognised as the most significant pressures on biodiversity at a regional level (SADEH 2005; Neagle 2003). At the paddock and station level, introduced predators are an equally significant threat and pressure on some native animals (Brandle 1998, Neagle 2003). Climate change and the other threats and pressures listed in Table 15 are all added pressures which no doubt have a combined impact on the persistence of biodiversity; however, we did not include them as part of the incentive policy design because either duty of care is being facilitated through other government initiatives (e.g. GABSI programs), the threats and pressures require management actions beyond the capacity of individual producers (e.g. climate change), or the threats and pressures are so localised that special incentives need to be developed (e.g. altered fire regimes).

After a more detailed assessment of the threats and pressures of TGP, related mechanical disturbance and introduced predators in the Stony Plains bioregion at the October 2005 and March 2006 workshops, we identified a list of key threats and pressures, which underpinned the design of the incentive policy (Box 5).

Box 4: Biodiversity values for the Stony Plains bioregion

- connected mosaics of extensive ecological communities/habitats across land types enabling genetic flows and species re-establishment across the landscape to maintain resilience of species and communities (i.e. compositional and structural attributes of biodiversity at the regional scale)
- connectivity of minor and island ecological communities/habitats to neighbouring ecological communities to maintain resilience of significant ecological communities (i.e. structural attributes of biodiversity in significant ecological communities at the regional scale)
- relatively uninterrupted surface water flows across resource source and sink patches within land types to support highly dynamic flora and fauna assemblages (i.e. maintain functional biodiversity at the regional scale)
- the diversity of plant and animal assemblages across and within land types (i.e. compositional attributes of biodiversity at a sub-regional scale)
- endemic species and species for which the Stony Plains bioregion represents the largest area of suitable habitat for the species (i.e. compositional attributes of biodiversity at local scales)
- threatened species
- significant ecological communities (i.e. specific biodiversity attributes at local scales):

  • mound springs – internationally recognised heritage sites – geology and endemic species

  • gypsum clay plains – endemic and threatened plant species and important areas for native small mammal species including the nationally vulnerable Plains Mouse

  • breakaway hills – endemic and threatened plant species, distinctive flora and fauna assemblages, endemic reptile species including nationally vulnerable Bronze-backed Legless Lizard

  • drainage lines and floodplains – high plant and bird species richness; critical for most frog and fish species in the region

  • swamps – high periodic productivity provides important breeding habitat for aquatic fauna and waterbirds

  • waterholes – enable the survival of aquatic vertebrates (particularly fish) and sustain many bird species through dry periods

  • arid ranges – provide habitat for plant and animal species that have specialised for rocky range habitats and contribute to an archipelago of ranges that spans from the MacDonnell Ranges to the Flinders Ranges

  • areas of stony plains with gilgais – provide productive areas for native and non-native species following relatively minor rainfall events through the concentration of water and nutrients in the gilgais; important for the continuous existence of most small mammals in the region and low-shrub-dependent birds (e.g. Thick-billed Grasswren, *Amytornis textilis*)

  • areas of stony tableland with sand mounds – important habitat for small mammals adapted to hopping (e.g. Kultarr, *Antechinomys laniger*; Kowari, *Dasyuroides bynie*), ground-roosting birds (e.g. Gibber Bird, *Ashbyia lovensis*) that are susceptible to nocturnal predation in better vegetated areas.

Note: Based on assets described in SADEH (2005), Neagle (2003) and Brandle (1998)

Table 15: Threats and pressures affecting terrestrial biodiversity of the Stony Plains bioregion

Pressure	Description	Disturbance
Excessive total grazing pressure (TGP) and related mechanical disturbances	•Combined effects of grazing pressure from domestic stock, feral and native herbivores • Changes to the natural flow and/or flooding regimes of a watercourse due to diversions or the building of artificial flow barriers and storage areas, tracks, dams and other infrastructure	•Loss of vegetation cover • Increased land degradation through soil erosion • Reduction in recruitment of grazing-intolerant native plant species • Increase in the recruitment of some unpalatable, grazing-favoured native plant species • Loss of native animals due to competition for resources • Habitat loss or reduction in habitat quality • Invasion of weeds and disease • Degradation of ecosystem functioning • Disruption of dispersal mechanisms of aquatic species • Loss of refuges • Increased land degradation through erosion and salinity
Introduced predators	• Densities of introduced carnivores increase the predation and mortality rate of native animal populations to levels beyond natural recruitment rates	• Decline/loss in local populations of native animals • Loss of species at the regional level • Change in local ecosystem dynamics and composition
Climate change	• Changes in rainfall patterns and temperatures at rates greater than those to which species can adapt	• Contraction of species distributions • Shifts in the location of habitat and its quality • Threatened species become extinct • Increase in invasive species
Reduced water pressure of Great Artesian Basin (GAB)	• Extraction rates of water decreases GAB water pressure and flow of water to the surface	• Decreased availability of water at natural springs reducing aquatic habitat quality • Decrease in GAB-dependent biotic communities
State infrastructure	• Changes to the natural flow and/or flooding regimes of a watercourse due to diversions or the building of artificial flow barriers and storage areas, roads, highways, seismic lines etc.	• Degradation of ecosystem functioning • Loss of refuges • Increased land degradation through erosion and salinity
Changed fire regimes	• Changes in the intensity, season and frequency of fire which are so rapid that species cannot adapt to the new regimes	• Changes in ecosystem structure and habitat value • Decline/loss in local populations of plants and animals
Pollution	• Poor quality of ground and/or surface water caused by human interventions	• Loss of local native species • Decline in the habitat value in and surrounding waterholes

Note: Based on SADEH 2005

Box 5: Key threats and pressures on terrestrial biodiversity in the Stony Plains bioregion

1. Loss, fragmentation and degradation of ecological communities
   - high total grazing pressure due to:
     - intensification of watered areas
     - development of new waters in areas historically remote from water
     - overgrazing by:
       - domestic stock
       - camels (only some land types)
       - donkeys (only some land types)
       - horses
       - rabbits (only some land types)
       - kangaroos.

2. Species loss
   - increased predation of fragmented or rare native fauna populations due to:
     - introduced predators:
       - fox
       - cat
     - impact of reducing dingo populations
     - changed habitat structure caused by large herbivores (overgrazing and trampling).
   - loss of adult plants and their recruitment (refer to total grazing pressure)
     - zero grazing pressure may be required to maintain some species populations
     - competition from invasive introduced plant species.

3. Change in natural surface water flows
   - building of dams and drainage networks to fill dams impacts the resources of downstream run-on areas
   - building of tracks with substantial windrows across gibber flats changes water flow patterns.

3. Biodiversity conservation priorities

The Stony Plains bioregion is rich in assets and has many key biodiversity values that are threatened significantly. The conservation priorities identified in our workshops for sustaining terrestrial biodiversity in the Stony Plains bioregion are listed in Box 6.

Box 6: Biodiversity conservation priorities for the Stony Plains bioregion

- manage total grazing pressure (TGP) across watered areas to avoid further degradation of biodiversity and production values
- manage threats and pressures on species vulnerable to extinction in areas where they are known to occur
- plan infrastructure development to avoid impacting natural surface water flow.

Producers in cooperation with government agencies are well positioned to make appropriate management interventions as part of grazing land management planning for their leases, to sustain native biodiversity in the arid grazed rangelands.

4. Duty of care

There are no facilitative or incentive-based conservation programs operating in the Stony Plains bioregion. Instead, 'duty of care' responsibilities for biodiversity are achieved by coercion through penalties of a number of government instruments listed in Appendix 7 and summarised by the following legislation:

- *Natural Resources Management Act* 2004
- *Native Vegetation Act* 1991
- *Crown Lands Act* 1929
- *National Parks and Wildlife Act* 1972
- *Environment Protection and Biodiversity Conservation Act* 1999 (Cwth).

The sectors responsible for duty of care are primary producers (pastoral lessees or managers), state government agencies and NRM boards (Box 7). Generally, it is a collaborative effort between government NRM agencies and the producer, depending on the nature of the threats and pressures. The sectors responsible for TGP and related mechanical disturbances, species loss, and surface water flows are as follows:

4.1 TGP and related mechanical disturbances

All facets of TGP are the responsibility of the producers (i.e. pastoral lessees or managers) except in the case of control of camels and kangaroos. Managing these herbivores could need a cooperative regional response by producers, shooters, Aboriginal landholders and government agencies to get effective reductions because of the animals' mobility. The Australian Government Department of the Environment and Water Resources as legislated responsibilities for kangaroo harvesting under the *National Parks and Wildlife Act* 1972.

4.2 Species loss

For flora and fauna, detailed ecological information and monitoring is often required to enable effective management. South Australian government agencies and NRM boards have legislative responsibilities and avenues of funding to help such programs. Where TGP is a factor, the pastoral lessees/managers need to work cooperatively with these groups.

4.3 Reduced natural surface water flows

Producers, the Department of Transport in South Australia, contractors and mining companies are responsible for planning and building roads and tracks in the region. The building of artificial flow barriers (earthen dam walls in drainage lines and related channelling banks) is the responsibility of producers.

Producers, therefore, are wholly responsible for managing TGP and related mechanical disturbances (i.e. reduced natural surface water flows). Where species loss is caused by TGP, producers have a responsibility to work cooperatively with government agencies. In other instances of species loss (e.g. predation by introduced predators), the South Australian government agencies have responsibility, although some producers already provide information to government agencies on threats and pressures that may affect conservation-rated species.

Box 7: The sectors responsible for managing key threats and pressures on terrestrial biodiversity in the Stony Plains

1. Total grazing pressure and related disturbances
   - Producers (pastoral lessees or manager).
2. Species loss
   - Related to total grazing pressure
     - Producers (pastoral lessees or manager)
     - State government agencies and NRM boards
   - Other threats and pressures
     - State government agencies.
3. Reduced natural surface water flows
   - Producers (pastoral lessees or manager).

Appendix 7: Legislation covering ‘duty of care’ obligations and penalties in the South Australian rangelands

Natural Resources Management Act **2004**	
Duty of care obligations	**Penalties**
Water • The obligations imposed by the *Water Resources Act* 1997 for authorisations required for consuming water, and related obligations, have been largely transferred to the new *Natural Resources Management Act* 2004. • Importantly, there now exists a specific duty on landowners to take reasonable measures to prevent damage to the bed and banks of watercourses and related ecosystems in or adjacent to their property. Pest Plants and Animals • With some modification, the obligations imposed by the *Animal and Plant Control Act* 1986 are transferred to the *Natural Resources Management Act* 2004. • A landowner who has been served with a notice to prepare an action plan must do so and comply with the provisions of that plan. Management and protection of land • A landowner who is, or is likely to be, in breach of the general statutory duty under the Act resulting or likely to result in land degradation may be required to prepare an action plan. • Failure to comply with a notice requiring preparation of an action plan is an offence.	• In addition to the range of penalties imposed for breaches of specific provisions of the Act, it is an offence to fail to comply with a protection order issued under the Act. Maximum penalty: for a domestic activity for the purposes of securing compliance with the general statutory duty – $2500 (expiation fee – $250); all other cases – $50 000 (expiation fee – $750). • It is an offence to fail to comply with a reparation order issued under the Act. Maximum penalty – $50 000; expiation fee – $750. • The Environment, Resources and Development (ERD) Court has the power, where it considers it appropriate, to award exemplary damages if there is an application for civil enforcement of the Act.
Farm development and use A landowner has a duty of care: • not to take water from a prescribed watercourse, lake or well or take surface water from surface water prescribed area without an appropriate water licence • to comply with applicable natural resource management plans and water allocation plans • not to erect, construct or enlarge a dam, wall or other structure that will collect or divert water flowing in a prescribed watercourse without a permit or a licence to do so • to comply with the Minister’s directions with respect to the rectification of unauthorised activity and restrictions to water use • to comply with directions given by a ‘relevant authority’ with respect to rectifying an unauthorised activity • to comply with the conditions of a licence and to not take more water than the amount allocated.	• Taking water from a prescribed watercourse or a surface water prescribed area without a licence, breaching a condition of a licence or taking water in contravention of an NRM plan: Body corporate – $70 000; natural person – $35 000; calculation of penalty if taking excess water – $25/kilolitre; expiation fee for breach of prescribed condition of licence – $750. • In certain circumstances, erecting, constructing or enlarging a dam, wall or other structure that will collect or divert water without approval or a licence: Body corporate – $70 000; natural person – $35 000. • Misleading, obstructing, hindering etc. an authorised officer or failing to comply with directions given by an officer: Maximum penalty – $5000. • Giving misleading information to the Minister, a relevant authority or to an authorised officer – $20 000. • Failing to comply with a notice to rectify an unauthorised activity: Body corporate – $50 000; natural person – $25 000. • Failing to comply with a notice restricting or prohibiting taking of water: Maximum penalty – $50 000 (company); $25 000 (individual); expiation fee – $315. • Failure to comply with water conservation measures as prescribed by regulation: Maximum penalty – $10 000 (company); $5000 (individual); expiation fee – $315. • Breaches of the Act by employees and agents are taken to be breaches of the Act by the employer or principal.
	• Where a company is guilty of an offence under the Act, the directors and managers of that company are guilty of the same offence.

Native Vegetation Act **1991**	
A landowner has a duty of care: • not to clear native vegetation unless authorised by the Native Vegetation Council or exempted from the operation of the Act (that is, the requirement for authorisation) by the Native Vegetation Regulations, 1991 • to comply with the conditions of an authorisation to clear native vegetation issued by the Native Vegetation Council • to comply with the provisions of a heritage agreement.	• Clearing native vegetation without approval unless exempted from the operation of the Act: Maximum penalty – $100 000 or a sum calculated at the prescribed rate per hectare of the land to which the offence relates, whichever is greater. Additionally, the court must make an order requiring a person contravening the Act to make good the default by, for example, demolishing any buildings established and revegetating the land in question. Failure to comply with such an order is also an offence: Maximum penalty – $100 000 in addition to any penalties the court may award for contempt. • Failing to comply with an enforcement notice: Maximum penalty – $10 000. • Hindering, abusing, threatening etc. an authorised officer: Maximum penalty – $4000 and/or up to one year imprisonment. • It is a defence to a charge under the Act to show that the offence was not committed intentionally and did not result from a failure to take reasonable care. • Company directors may be held personally liable for offences committed by the company. • It is a defence to any offence under the Act to show that the offence was not committed intentionally and did not result from a failure to take reasonable care.
Pastoral Land Management and Conservation Act **1989**	
A landowner has a duty of care: • to comply with a general duty to carry out enterprise activities in accordance with good land management practices, to prevent the degradation of land and to try to improve the condition of the land • to comply with the conditions of the pastoral lease; a condition of all pastoral leases is compliance with the *Native Vegetation Act* 1991; generally, clearing native vegetation for continuing pastoral purposes does not require approval under the Act • not to misuse pastoral lands by, among other things, cutting down, lopping branches off, or otherwise damaging any living trees or bushes.	• Misusing pastoral land by cutting down, lopping branches from or otherwise damaging any living tree or bush on pastoral land: Maximum penalty – $10 000; expiation fee – $315 • Breaching the conditions of a pastoral lease (all pastoral leases require that the *Native Vegetation Act* 1991 is complied with): Maximum penalty – $10 000. A breach of the conditions of a lease can lead to a cancellation of the lease if the lessee has been given a reasonable opportunity to make good the breach but failed to do so and it is necessary to cancel the lease to prevent, stop or minimise damage to or deterioration of the land. • Hindering, obstructing or abusing an authorised officer: Maximum penalty – $2500; expiation fee – $210. Assaulting an authorised officer: Maximum penalty – $2500 or imprisonment for six months. • Travelling across or camping on pastoral land and failing to comply with a direction given by an authorised person: Maximum penalty – $1250. • It is a defence to a charge of misusing pastoral land to show lawful authority or excuse. • It is a defence against any offence under the Act to show that reasonable care was taken to avoid the commission of the offence.
Crown Lands Act **1929**	
• A landowner has a duty of care not to injure or destroy any trees, shrubs or saplings on Crown land, or land leased or dedicated under the Act or under the *Pastoral Land Management and Conservation Act* 1989, unless in accordance with a licence or in exercising or performing any rights or duties imposed under a lease. • It is a condition of every lease or agreement that at least 2 hectares of every 100 be set aside for growing timber, and that no such trees shall be destroyed. This requirement does not apply to leases or agreements involving less than 100 hectares. • It is a condition of every lease or agreement that the lessee or buyer will set apart and keep reserved for the purpose of preventing soil erosion, areas of land covered with natural scrub growth as specified by the Minister. • Conditions about stocking numbers must be contained in every lease and agreement.	• Injuring or destroying vegetation on Crown land, or land leased or dedicated under the Act or under the *Pastoral Land Management and Conservation Act* 1989, unless in accordance with a licence or in exercising or performing any rights or duties imposed under a lease: Maximum penalty – $20 or two months imprisonment. • Injuring or destroying vegetation in contravention of a lease or agreement: Maximum penalty – $70. • Breach of the conditions of a lease or agreement: No financial penalty. However, notice of the breach must be given by Crown Lands SA. If the breach then continues, or is committed again, the Crown may exercise powers of forfeiture or cancellation. • Obstructing a Crown lands ranger in the course of their work: Maximum penalty – $100 or six months imprisonment.

National Parks and Wildlife Act **1972**	
A landowner has a duty of care: • not to 'take' a native plant on a reserve, wilderness protection area, wilderness protection zone, land reserved for public purposes, a forest reserve or any other Crown land • not to 'take' a native plant on private land without the consent of the owner • not to 'take' a protected animal or the eggs of a protected animal without approval • not to keep protected animals unless authorised to do so • not to use poison to kill a protected animal without approval • to comply with the conditions imposed on permits and approvals.	• Taking a native plant or protected animal: Maximum penalty – $100 000 or imprisonment for two years in the case of a marine mammal; $10 000 or imprisonment for two years in the case of an animal (not being a marine mammal), or the eggs of an animal, of an endangered species; $7500 in the case of an animal (not being a marine mammal), or the eggs of an animal, of a vulnerable species; $5000 or 12 months imprisonment in the case of an animal (not being a marine mammal), or the eggs of an animal, of a rare species; $2500 or six months imprisonment in any other case. • Taking a plant of a prescribed species on private land: Maximum penalty – $10 000 or imprisonment for two years in the case of an endangered species; $7500 or imprisonment for 18 months in the case of a vulnerable species; $5000 or 12 months imprisonment in the case of a rare species; and $2500 or six months imprisonment in any other case. • Taking a native plant on private land without the consent of the owner of the land: Maximum penalty – $1000; expiation fee – $150. • Keeping or selling protected animals without a permit: Maximum penalty – $2500. • Importing or exporting a protected animal into or out of the state without a permit to do so: Maximum penalty – $2000; expiation fee – $200. • Possession of an illegally taken or acquired animal, carcass of an animal, or egg: Maximum penalty – $100 000 or two years imprisonment in the case of a marine mammal or carcass of a marine mammal; $10 000 or two years imprisonment in the case of an animal (not being a marine mammal), or the carcass or eggs of an animal, of an endangered species; $7500 in the case of an animal (not being a marine mammal), or the carcass or eggs of an animal, of a vulnerable species; $5000 or 12 months imprisonment in the case of an animal (not being a marine mammal), or the carcass or eggs of an animal, of a rare species; $2500 or six months imprisonment in any other case. • Using poison for the purpose of taking a protected animal without a permit; taking a protected animal through the use of poison: Maximum penalty – $2000. • Hunting, or having hunting equipment without a permit: Maximum penalty – $1000; expiation fee – $150. • Failing to comply with the conditions of a Ministerial authorisation for the taking of natural plants or protected animals: Maximum penalty – $2500; expiation fee – $210. • Hindering a warden: Maximum penalty – $2500. • If more than one animal is involved in an offence, an additional penalty for each animal is payable. The maximum additional penalty is: $1000 in the case of an endangered species, $750 in the case of a vulnerable species, $500 in the case of a rare species, and $250 in any other case. • Intentionally destroying or damaging part of a reserve or property without lawful authority: Maximum penalty – $2000 or imprisonment for six months. Also, if convicted of this offence a person may be required to pay the Minister or a co-management board money in compensation for the damages caused. • It is a defence to any offence under the Act to prove that the offending action was done in compliance with a requirement under another Act – for example, the *Native Vegetation Act* 1991 or the *Natural Resources Management Act* 2004. It is also a defence to show that the act was done neither intentionally nor negligently. • Indigenous Australians are exempted from many of the provisions of the Act, including the need for a licence, and certain prohibitions on taking native plants, protected animals or eggs of a protected animal.

Environment Protection and Biodiversity Conservation Act **1999 (Commonwealth)**	
A landowner has a duty of care: • not to undertake an action that may have a 'significant impact' on a matter of 'national environmental significance' without approval • not to undertake an action that may have a 'significant impact' on the environment on Commonwealth lands. • not to intentionally or recklessly kill or injure a member of a listed threatened species or community without approval • not to knowingly damage a 'critical habitat' • to comply with regulations relating to activities in declared conservation zones • not to import or export native animals without a permit to do so.	• Taking an action that has, will have, or is likely to have a significant impact on a matter of national environmental significance without approval: Maximum penalty – $46 200 and/or imprisonment for up to seven years. There is also the potential for a civil penalty of $5.5 million (company); $550 000 (individual). • Taking an action that has, will have, or is likely to have a significant impact on the environment in Commonwealth land or taking an action on Commonwealth land that has, will have, or is likely to have a significant impact on the environment without approval: Maximum penalty – $13 200 and/or two years imprisonment. There is also potential for a civil penalty of $1.1 million (corporation); $110 000 (individual). • Taking an action that results, will result, or is likely to result in a significant impact on the national heritage values of a National Heritage listed place: Maximum penalty – $46 200 and/or imprisonment for seven years. The court may fine a corporation up to five times the maximum penalty applicable to an individual for this offence. The offence may be committed only where the Commonwealth has jurisdiction; for example, where the offence is committed in a Commonwealth area or territory or the actions offend against a relevant international agreement to which the Commonwealth is a party. There is also potential for a civil penalty of $5.5 million (corporation); $550 000 (individual). • Killing, injuring or taking a member of a listed threatened species or community in a Commonwealth area without a permit: Maximum penalty – $110 000 and/or imprisonment for two years.
	• Failing to notify the Secretary of the Department of the Environment and Water Resources of the death, injury or taking of a member of a listed threatened species or community: Maximum penalty – $11 000. • Causing significant damage to an area of critical habitat: Maximum penalty – $110 000 and/or two years imprisonment. • Contravening a conservation order: Maximum penalty – $5500. • Providing false or misleading information to get an approval or permit: Maximum penalty – $13 200 and/or two years imprisonment. • Providing false or misleading information to an authorised officer or the Minister: Maximum penalty – $6600 and/or one year imprisonment. • Causing significant damage to an area of critical habitat: Maximum penalty – $110 000 and/or two years imprisonment. • Contravening a conservation order: Maximum penalty – $5500. • Providing false or misleading information to get an approval or permit: Maximum penalty – $13 200 and/or two years imprisonment. • Providing false or misleading information to an authorised officer or the Minister: Maximum penalty – $6600 and/or one year imprisonment. • Directors of companies may be personally liable for the actions of the company. It is a defence to show that reasonable steps were taken to prevent the company from contravening the Act. • A person who has contravened the Act may be liable to compensate people affected by the contravention for their loss or damage.

Appendix 8: Ecological function of biodiversity values

As identified by a panel of technical experts.

Biodiversity values	Function
Vegetation cover, floristic diversity, structural complexity, negligible feral animals (rabbits, donkeys, camels, feral horses), pre-settlement kangaroo densities	Vegetation provides food for herbivores, cover for resource retention, and habitats for animals. Feral animals and high densities of kangaroos add to the total grazing pressure of already disturbed plant ecosystems.
Endemic and threatened species, grazing-intolerant species, significant ecological communities (gypsum clay plains, stony plains with gilgais, breakaway hills, drainage lines and flood plains, arid ranges, stony tableland with sand mounds), pre-settlement densities of dingos, negligible foxes, cats and non-native invasive weeds	Grazing-intolerant plant species that are an iconic complement of the floristic diversity contribute to ground cover for retaining resources and provide habitat for fauna. They are also a direct measure of significant components of biodiversity. Dingos are mesopredators of cats and foxes, and weeds homogenise natural ecosystems by out-competing native vegetation, especially when it is subject to excessive grazing pressure. (NB. Significant ecological communities were considered special cases of conservation that needed a different suite of incentives. As a result, we did not consider the function further).
Landscape function of natural surface water flow and drainage lines	They provide landscape-scale habitats for aquatic life cycle development, source subpopulations of metapopulations, breeding and dispersal, and are important sources of water for terrestrial wildlife and livestock.
Interconnected tracts of ecological communities	They preserve the natural heritage values.

Appendix 9: Potential achievement measures for the Stony Plains case study

As identified by a panel of technical experts and a review of literature[1].

Attribute	Type of surrogate	GIS-derived[2]	Field assessment	Likelihood[3]
Composition				
Number of persistent native perennial plant species	True	No	Yes, plot-based	Medium
Presence of invasive weeds	Estimator	No	Yes, photopoints	High
Macropod numbers	Estimator	No	Yes, spotlighting	High
Camel numbers (track counts/dung)	Estimator	No	Yes, transect	High
Donkey numbers (track counts/dung)	Estimator	No	Yes, transect	High
Horse numbers (track counts/dung)	Estimator	No	Yes, transect	High
Number of active rabbit warrens	Estimator	Yes*	Yes, confirm GIS data	High
Presence of dingos (sightings/track counts)	Estimator	No	Yes, transect	Low
Presence of foxes (sightings/track counts)	Estimator	No	Yes, transect	Low
Insect abundance	True	No	Yes, transect	Medium
Vegetation structural complexity				
Cover of persistent native perennial vegetation	True	Yes*	Yes, confirm GIS data	High
Diversity of age classes for long-lived perennials	True	No	Yes, plot-based	Medium
Cover of weeds	Estimator	Yes*	Yes, confirm GIS data	High
Number of trees with large tree hollows	True	No	Yes, transect	Medium
Vegetation condition				
Resilience of native perennial vegetation cover	Estimator	Yes*	Yes, confirm GIS data	High
Landscape function of native perennial vegetation cover	Estimator	No	Yes, confirm leakiness	Medium
Leakiness index	Estimator	Yes*	No	Medium
% cover production loss	Estimator	Yes*	Yes, confirm GIS data	High
Stocking rate in dry conditions	Estimator	No	Yes	Low
Landscape context				
Density of waters in paddock/station	Estimator	Yes	Yes	High
Neighbourhood of resilient perennial vegetation	True	Yes*	No	High
Conservation significance				
Vulnerability of biodiversity	True	Yes*	Yes, confirm modelling	Medium
Regionally significant native vegetation type	Value	Yes	No	High
Presence of conservation-related species	True	No	Yes	Low
Number of palatable perennial species	True	No	Yes, plot	High
Site of previous biological survey effort	Estimator	Yes	No	High
Evidence of infrastructure to protect special sites	Estimator	No	Yes	High
% area of water-remote areas	Estimator	Yes	No	High
Evidence of early warning reporting of threats and pressures on conservation-related species	Estimator	No	No	High
Property environmental plan	Estimator	No	No	Medium
Evidence of protecting natural water flows	Estimator	No	Yes	High

1 Smyth, James and Whiteman (2003) and Hunt et al. (2006)

2 Data that can be derived using GIS techniques; Yes* means that scoping studies are being done but more research is needed before they can be rolled out at the regional level

3 The likelihood of the measure having widespread appeal for implementation

Appendix 10: Potential management actions for the Stony Plains case study

MU = management unit, PC =primary producer capacity, SC = scientific credibility WP = whole property, R = regional, R/S = regional or sub-regional, S = sub-regional, Lc = local L = low, M = medium, H = high

Desired outcome	Biodiversity values	Threats and pressures	Potential management actions	MU	PC	SC
1. Native vegetation typical of the Stony Plains communities retained or restored in the short and medium terms	• Vegetation cover • Plant diversity • Structural complexity • Negligible numbers of rabbits, donkeys, camels, feral horses • Pre-settlement kangaroo densities	Loss, fragmentation and degradation of ecological communities by high total grazing pressure due to: • intensification of watered areas • installation of new waters in historically water-remote areas • overgrazing by domestic stock, camels, donkeys, horses, kangaroos and rabbits (only some land types)	• Reduce stocking rate • Destock early before signs of degradation • Reduce feral herbivores and kangaroos • Sow native perennial, palatable plants • Develop a drought plan • Close waters • Fence dams • Control flowing bore • Develop a water management plan to supplement water-remote area network and implement over time • Align new fencing with land system boundaries • Contribute to water-remote area network • Take out a Heritage Agreement	WP WP R/S WP S WP WP WP S S R S	H M M/H L H H H H H L L L	H M M H L H M M L M M H
2. Loss of existing complement of rare and regionally significant native species, populations and ecological communities reduced in the short and medium terms	• Endemic and threatened species and communities • Species inflexible to grazing • Significant ecological communities (gypsum clay plains, stony plains with gilgais, breakaway hills, drainage lines and flood plains, arid ranges, stony tableland with sand mounds) • Pre-settlement densities of dingos • Negligible numbers of foxes and cats • Negligible introduced weeds	• Introduced predators • Competitor pressure by invasive weeds • Disease • Total grazing pressure on grazing-sensitive species	• Biological control (reduce dingo baiting) • Mechanical control (cats and foxes) • Preventive controls • Post-establishment controls (fence special sites) • Quarantine • Control invertebrate herbivores • Use other TGP controls listed above for grazing-sensitive species	WP S Lc lc S Lc -	H L H L L H -	M H H L L M -
3. Natural surface water flows of natural drainage lines maintained or restored	• Landscape function	Loss of landscape function due to: • building of dams and drainage redirection networks to fill dams • building of tracks with substantial windows redirects water flow patterns	• Destroy artificial earthworks to redirect water flow • Grade windrows on tracks when required	WP S	M M	H M
4. Mosaic of water-remote areas of biodiversity significance managed by producers for the Stony Plains region in the short term	• Interconnected tracts of functioning ecological communities	Loss, fragmentation and degradation of ecological communities by high total grazing pressure due to: • intensification of watered areas • installation of new waters in historically water-remote areas • overgrazing by domestic stock, camels, donkeys, horses, kangaroos and rabbits (only some land types)	• Reduce stocking rate • Destock early before signs of degradation • Reduce feral herbivores and kangaroos • Sow native perennial, palatable plants • Develop a drought plan • Close waters • Fence dams • Control flowing bores • Develop a water management plan to supplement water-remote area network and implement over time • Align new fencing with land system boundaries • Contribute to water-remote area network • Take out a Heritage Agreement	WP WP R/S WP S WP WP WP S S R S	H M M/H L H H H H H L L L	H M M H L H M M L M M H

Appendix 11: Persistent native plant taxa in the Stony Plains bioregion

Compiled by botanists from SADEH biological surveys and SADWLBC pastoral monitoring datasets (n=353)

Abutilon cryptopetalum	*Astrebla pectinata*	*Digitaria coenicola*	*Eriochloa pseudoacrotricha*
Abutilon fraseri	*Atalaya hemiglauca*	*Diplachne fusca*	*Eucalyptus camaldulensis*
Abutilon halophilum	*Atriplex elachophylla*	*Diplatia grandibractea*	*Eucalyptus coolabah*
Acacia aff. papyrocarpa	*Atriplex holocarpa*	*Dipteracanthus australasicus*	*Eucalyptus intertexta*
Acacia aneura	*Atriplex incrassata*	*Disphyma crassifolium*	*Eucalyptus oleosa*
Acacia ayersiana	*Atriplex nummularia*	*Dissocarpus paradoxus*	*Eucalyptus socialis*
Acacia burkittii	*Atriplex quinii*	*Dodonaea lobulata*	*Eulalia aurea*
Acacia calcicola	*Atriplex stipitata*	*Dodonaea microzyga*	*Euphorbia stevenii*
Acacia cambagei	*Atriplex vesicaria*	*Dodonaea viscosa*	*Euphorbia tannensis*
Acacia clelandii/brachystachya	*Boerhavia schomburgkiana*	*Eleocharis pallens*	*Exocarpos aphyllus*
Acacia colletioides	*Bolboschoenus caldwellii*	*Enchylaena tomentosa*	*Fimbristylis dichotoma*
Acacia coriacea	*Brachyachne ciliaris*	*Enteropogon acicularis*	*Frankenia crispa*
Acacia cyperophylla	*Callitris glaucophylla*	*Enteropogon ramosus*	*Frankenia cupularis*
Acacia estrophiolata	*Calotis hispidula*	*Epaltes cunninghamii*	*Frankenia foliosa*
Acacia farnesiana	*Calotis kempei*	*Eragrostis australasica*	*Frankenia pauciflora*
Acacia kempeana	*Casuarina pauper*	*Eragrostis eriopoda*	*Frankenia plicata*
Acacia ligulata	*Centipeda cunninghamii*	*Eragrostis falcata*	*Frankenia serpyllifolia*
Acacia minyura	*Centipeda thespidioides*	*Eragrostis laniflora*	*Frankenia sessilis*
Acacia murrayana	*Cheilanthes lasiophylla*	*Eragrostis setifolia*	*Gnephosis arachnoidea*
Acacia nyssophylla	*Cheilanthes sieberi*	*Eragrostis xerophila*	*Goodenia chambersii*
Acacia oswaldii	*Chenopodium auricomum*	*Eremophila alternifolia*	*Goodenia cycloptera*
Acacia papyrocarpa	*Chenopodium gaudichaudianum*	*Eremophila battii*	*Goodenia saccata*
Acacia ramulosa	*Chenopodium nitrariaceum*	*Eremophila bignoniiflora*	*Gossypium sturtianum*
Acacia rivalis	*Citrus glauca*	*Eremophila clarkei*	*Grevillea juncifolia*
Acacia salicina	*Codonocarpus cotinifolius*	*Eremophila deserti*	*Grevillea nematophylla*
Acacia sibirica	*Commicarpus australis*	*Eremophila duttonii*	*Grevillea stenobotrya*
Acacia stenophylla	*Cratystylis conocephala*	*Eremophila freelingii*	*Grevillea striata*
Acacia tarculensis	*Crinum flaccidum*	*Eremophila gilesii*	*Gunniopsis quadrifida*
Acacia tetragonophylla	*Crotalaria eremaea*	*Eremophila glabra*	*Gunniopsis tenuifolia*
Acacia victoriae	*Cullen australasicum*	*Eremophila latrobei*	*Gunniopsis zygophylloides*
Adriana tomentosa	*Cymbopogon ambiguus*	*Eremophila longifolia*	*Hakea divaricata*
Alectryon oleifolius	*Cymbopogon obtectus*	*Eremophila macdonnellii*	*Hakea ednieana*
Amyema maidenii	*Cynanchum floribundum*	*Eremophila maculata*	*Hakea leucoptera*
Amyema miquelii	*Cyperus alterniflorus*	*Eremophila neglecta*	*Hakea lorea*
Amyema miraculosa	*Cyperus bifax*	*Eremophila oppositifolia*	*Haloragis aspera*
Amyema preissii	*Cyperus bulbosus*	*Eremophila paisleyi*	*Haloragis glauca*
Amyema quandang	*Cyperus centralis*	*Eremophila pentaptera*	*Halosarcia halocnemoides*
Aristida holathera	*Cyperus exaltatus*	*Eremophila rotundifolia*	*Halosarcia indica*
Aristida inaequiglumis	*Cyperus gymnocaulos*	*Eremophila scoparia*	*Halosarcia pergranulata*
Aristida latifolia	*Cyperus laevigatus*	*Eremophila serrulata*	*Halosarcia pluriflora*
Aristida nitidula	*Cyperus victoriensis*	*Eremophila sturtii*	*Hemichroa diandra*
Aristida obscura	*Dichanthium sericeum*	*Eremophila willsii*	*Hemichroa mesembryanthema*
Aristida personata	*Dicrastylis costelloi*	*Eriachne helmsii*	*Hibiscus sturtii*
Aristida strigosa	*Digitaria ammophila*	*Eriachne mucronata*	*Imperata cylindrica*
Astrebla lappacea	*Digitaria brownii*	*Eriachne ovata*	*Indigofera basedowii*

Indigofera georgei	*Marsilea drummondii*	*Scaevola depauperata*	*Sida intricata*
Indigofera leucotricha	*Marsilea exarata*	*Scaevola spinescens*	*Sida petrophila*
Indigofera linnaei	*Marsilea hirsuta*	*Schoenoplectus litoralis*	*Sida sp. B* (C.Dunlop 1739)
Indigofera psammophila	*Melaleuca glomerata*	*Sclerolaena articulata*	*Sida sp. F* (Latz 7459)
Isotoma petraea	*Melaleuca lanceolata*	*Sclerolaena bicornis*	*Sida spodochroma*
Juncus kraussii	*Melaleuca uncinata*	*Sclerolaena bicuspis*	*Sida trichopoda*
Kippistia suaedifolia	*Melhania oblongifolia*	*Sclerolaena brachyptera*	*Solanum chenopodinum*
Lawrencia squamata	*Mentha australis*	*Sclerolaena constricta*	*Solanum coactiliferum*
Lechenaultia divaricata	*Minuria cunninghamii*	*Sclerolaena convexula*	*Solanum ellipticum*
Leiocarpa leptolepis	*Minuria integerrima*	*Sclerolaena cornishiana*	*Solanum lasiophyllum*
Leiocarpa semicalva	*Monachather paradoxus*	*Sclerolaena cuneata*	*Solanum orbiculatum*
Leiocarpa tomentosa	*Muehlenbeckia coccoloboides*	*Sclerolaena diacantha*	*Solanum petrophilum*
Leiocarpa websteri	*Muehlenbeckia florulenta*	*Sclerolaena divaricata*	*Solanum quadriloculatum*
Leptochloa digitata	*Myoporum montanum*	*Sclerolaena eriacantha*	*Solanum sturtianum*
Leptochloa fusca	*Myoporum platycarpum*	*Sclerolaena glabra*	*Spartothamnella teucriiflora*
Lomandra leucocephala	*Myriophyllum verrucosum*	*Sclerolaena holtiana*	*Sporobolus mitchellii*
Lycium australe	*Neobassia proceriflora*	*Sclerolaena intricata*	*Sporobolus virginicus*
Lysiana exocarpi	*Neurachne munroi*	*Sclerolaena limbata*	*Stemodia florulenta*
Lysiana murrayi	*Nitraria billardierei*	*Sclerolaena longicuspis*	*Stemodia glabella*
Lysiana subfalcata	*Olearia decurrens*	*Sclerolaena muricata*	*Stemodia sp. Haegii* (J.Z.Weber 9055)
Maireana aphylla	*Panicum effusum*	*Sclerolaena obliquicuspis*	*Stemodia viscosa*
Maireana appressa	*Petalostylis labicheoides*	*Sclerolaena parallelicuspis*	*Templetonia egena*
Maireana astrotricha	*Phragmites australis*	*Sclerolaena tatei*	*Teucrium racemosum*
Maireana brevifolia	*Pimelea microcephala*	*Sclerolaena tricuspis*	*Themeda triandra*
Maireana campanulata	*Pittosporum angustifolium*	*Sclerolaena uniflora*	*Threlkeldia inchoata*
Maireana carnosa	*Poa fordeana*	*Sclerolaena ventricosa*	*Thyridolepis mitchelliana*
Maireana eriantha	*Prostanthera althoferi*	*Sclerostegia arbuscula*	*Tribulus eichlerianus*
Maireana erioclada	*Prostanthera striatiflora*	*Sclerostegia disarticulata*	*Tribulus hystrix*
Maireana georgei	*Psydrax latifolia*	*Sclerostegia medullosa*	*Trichanthodium skirrophorum*
Maireana integra	*Pterocaulon serrulatum*	*Sclerostegia tenuis*	*Triodia basedowii*
Maireana lanosa	*Pterocaulon sphacelatum*	*Senecio cunninghamii*	*Triodia helmsii*
Maireana luehmannii	*Ptilotus obovatus*	*Senecio magnificus*	*Triodia irritans*
Maireana microcarpa	*Ptilotus parvifolius*	*Senna artemisioides*	*Tripogon loliiformis*
Maireana ovata	*Ptilotus sessilifolius*	*Senna cardiosperma*	*Typha domingensis*
Maireana pentatropis	*Rhagodia eremaea*	*Senna glutinosa*	*Zygochloa paradoxa*
Maireana pyramidata	*Rhagodia parabolica*	*Senna phyllodinea*	*Zygophyllum aurantiacum*
Maireana radiata	*Rhagodia spinescens*	*Senna pleurocarpa*	*Zygophyllum billardierei*
Maireana schistocarpa	*Rhagodia ulicina*	*Setaria basiclada*	*Zygophyllum crassissimum*
Maireana scleroptera	*Rhyncharrhena linearis*	*Setaria constricta*	
Maireana sedifolia	*Salsola kali*	*Setaria jubiflora*	
Maireana tomentosa	*Santalum acuminatum*	*Sida argillacea*	
Maireana triptera	*Santalum lanceolatum*	*Sida calyxhymenia*	
Maireana turbinata	*Sarcostemma viminale*	*Sida corrugata*	
Maireana villosa	*Sarcozona praecox*	*Sida cunninghamii*	
Marsdenia australis	*Scaevola albida*	*Sida filiformis*	

Part 4: Policy options for providing conservation incentives in the Australian rangelands

Russell Gorddard

Stuart Whitten

Anita Smyth

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Executive summary

This report makes recommendations on the use of market-based instruments in the Australian rangelands. It develops the themes identified in Part 1 of this report that identified issues which need addressing in developing a MBI policy. This part of the report is based on findings from three workshops that involved pastoralists in a range of market-based policy exercises. These workshops were held at Olympic dam, South Australia; Bokhara Plains, a property near Brewarrina in the north west of New South Wales; and Mitchell in Western Queensland.

Recommendations on the suitability and selection of market-based instruments for biodiversity management in the rangelands

A market-based approach to biodiversity policy in the rangelands would appear to be a feasible and valuable policy option. In addition, a well-designed market-based instrument (MBI) can overcome a number of deficiencies that exist in alternative policy approaches. Evidence for these conclusions comes from workshop trials of various market-based policy options and the experience of actual trials of conservation tenders in the rangelands.

A price-based tender approach, where the government acts as a purchaser of biodiversity outcomes, and the price is determined by selection of competing bids from potential participants, is the most likely to be successful in the rangelands.

The key potential benefit of a tender mechanism is that it can identify significant and cost-effective options for biodiversity conservation. It can do this by allowing producers to communicate their willingness and capability to achieve biodiversity outcomes, and revealing the relative costs of achieving different outcomes.

Key contract options

We can usefully classify contracts as input-, management-, output- or outcome-based. In general, input- and management-based contracts are easier to define and measure, but they involve a risk of the specified actions not achieving their ultimate objective. Outcome-based contracts are more difficult to define and measure. Pragmatically, contracts can focus on removing or reducing financial incentives for incompatible management and/or specifying key elements of biodiversity outcomes. Feasible options for specifying tender deliverables include:

1. stocking rates and destocking
2. metrics based on vegetation cover data derived from remotely sensing and on-site assessment
3. pest animal control
4. any other biodiversity goal that can be clearly defined and measured.

Simple input- and output-based contracts appear sufficiently robust to form the basis of a tender scheme. More sophisticated outcome-based measures and contracting options will evolve with use and research, improving the biodiversity management and decreasing the cost of compliance.

Further work is required to develop and trial suitable mechanisms for pest control. This could be run as a separate, but complementary tender.

Key issues for successful tenders

Biodiversity property rights are not effectively defined in most of the rangeland. A policy program that seeks to purchase management changes in this environment without first securing existing good management practices risks slippage in management standards on other lands and therefore achieving no net change.

Securing ongoing and improved management of areas that are currently in good condition is likely to be most cost effective. Such a scheme may help ensure biodiversity outcomes into the future in an environment of uncertain property rights. It will also need to be carefully communicated, as a history of purchasing management changes means this type of scheme may create confusion and prevent high value sites from being offered.

A MBI must recognise, support and build on existing personal motivations for biodiversity conservation. There is a significant risk that a poorly implemented scheme could reduce the personal motivation for existing good management of biodiversity. This requires clear and consistent signals of governments' desired biodiversity outcomes. Site visits as part of a tender process are also vital in supporting intrinsic motivation.

Other requirements for success include developing clearly defined and shared biodiversity objectives, and effective integration with sustainable production programs and national parks.

Biodiversity tender design recommendations

- Ensure acceptable participation rates via communication and regional trials.
- Base schemes regionally to develop appropriate tender mechanism and process.
- Start small to manage risk and allow time for tenders to be tailored to regions.
- Significant funding to ensure the benefits outweigh the start-up costs and the risks of diminishing intrinsically motivated biodiversity management.
- Provide medium-term funding: Medium-term contacts (5–10 year) to ensure effective management changes in a variable environment.
- Have flexible specifications which allow for innovation and encourage tailoring to local needs.
- Consider whole of lease contracts to control for intensification and adverse effects on biodiversity on other parts of the property.
- Minimise transaction and monitoring costs for all parties as managers' time can be a limiting factor in engagement in a tender process.

1. Background

This report makes recommendations on the use of market-based instruments in the Australian rangelands. It develops the themes identified in Part 1 of this report that identified issues which need addressing in developing a MBI policy. This part of the report is based on findings from three workshops that involved pastoralists in a range of market-based policy exercises. These workshops were held at Olympic dam, South Australia; Bokhara Plains, a property near Brewarrina in the north west of New South Wales; and Mitchell in Western Queensland.

The next section describes the workshop methodology. Following this is a brief description of the results from these workshops. The discussion begins by introducing a conceptual framework for biodiversity policy in rangelands and uses this framework to discuss some of the key findings from the workshops and identify some guiding principles for MBI design. The report concludes with recommendations for the design and implementation of a tender system for biodiversity conservation.

In both the results and recommendations section the report is structured to move from the general principles to more specific issues. One important finding from the workshops is the significance of regional variation in biophysical management issues and institutional arrangements. This variation makes a regionally based approach to MBI development important. Therefore many of the specifics of MBI design discussed here need to be addressed at the regional level. They are included here to document the range of issues and risks involved in MBIs, and to indicate where federal and state level issues, such as the duration of funding cycles, can influence the implementation of these policies at a regional scale.

Finally, there is a range of MBI pilots and trials currently being implemented in different regions in Australia. New issues and lessons are emerging from this work that can be used to improve the recommendations of this report.

2. Workshop methods

The workshops were conducted between July and September 2006. Each ran for one day and involved approximately ten pastoralists in a series of exercises to enable them to experience, and provide feedback on, different incentives and tender designs. After an introduction to MBIs and the tender process, workshop participants were given maps of hypothetical properties in the region and asked to submit practice tenders for different biodiversity management actions or outcomes. The property maps specified areas by land type, watering points, creek-lines if applicable for the region, and fences. The properties varied between producers. An example of a property map is shown in Figure 16.

Participants were asked to consider all other features of the property – for instance, stocking rates and seasonal conditions – to be the same as their own property. This method appears to provide enough realism to enable the pastoralists to take the exercise seriously while reducing concerns about privacy.

In general the three exercises were for tenders to:

- destock a paddock
- reduce or modify stocking rates for a paddock or water point
- maintain vegetation condition in an area at a specified condition level.

The tender exercises were designed to highlight the design issues with input- and outcome-based approaches. The specifics of the exercises were adapted to each region. Attempting to define alternative suitable contracts and discussing the implications of unsuitable contracts were part of the exercise.

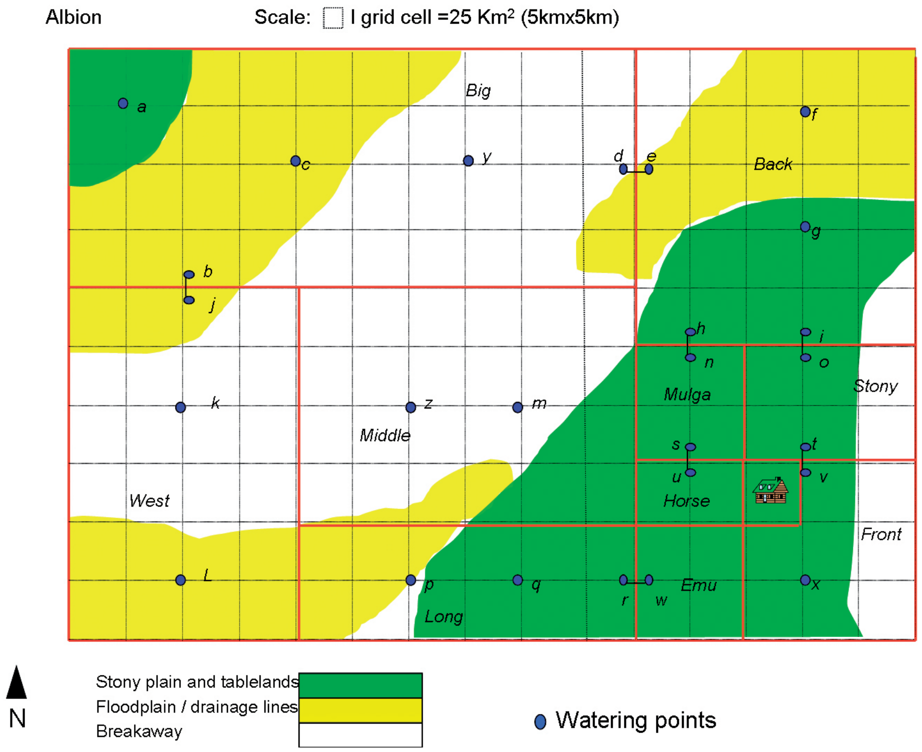


Figure 16: Example of the hypothetical property map used for the workshop exercises

After these exercises a questionnaire was conducted to identify potential participation rates, issues for participation and preferred tender design. The questionnaire is shown in Appendix 1. Questions focused on the following issues:

- likely uptake or participation in an MBI
- motivation for participation in a tender
- potential impediments to participation and cooperation
- perceptions of biodiversity
- support for different contract and design parameters (e.g. length of contract.)
- perceptions of the relationship between production and biodiversity
- workshop evaluation.

Participants were asked if they agreed or disagreed with a series of statements, and to respond on a five-point scale (strongly disagree, disagree, neither agree nor disagree, agree or strongly agree). For reporting purposes the questionnaire answers are classified as either agree, disagree or other. Other includes a 'neither agree nor disagree' response and no response. The percentage of respondents in each category, by workshop location, are reported as column graphs.

2.1 Limitations of results

There were 10 participants in each workshop who completed questionnaires. Given the small and self selective nature of the sample, results need to be treated with caution. However, tenders are also a selective mechanism so the results are likely to be representative of those who would respond to a biodiversity tender. Also, the main focus is on identifying potential impediments to effective tenders. The results should be viewed as signalling potential issues, rather than indicating likely rates of response to MBIs.

3. Workshop results

Results for the questionnaire and informal feedback from workshops is presented in the following sections.

3.1 Uptake or participation in an MBI

To test overall interest in participating in a biodiversity tender, participants were asked to respond to the following statement:

‘In general, I would consider being involved in a tender for biodiversity management.’

Results are displayed in Figure 17. Note that participants in QLD and NSW were generally familiar with tender schemes that had been run in their areas. Lack of familiarity may explain some of the lack of interest in SA. Other reasons for participation results are discussed under the headings of motivations and impediments.

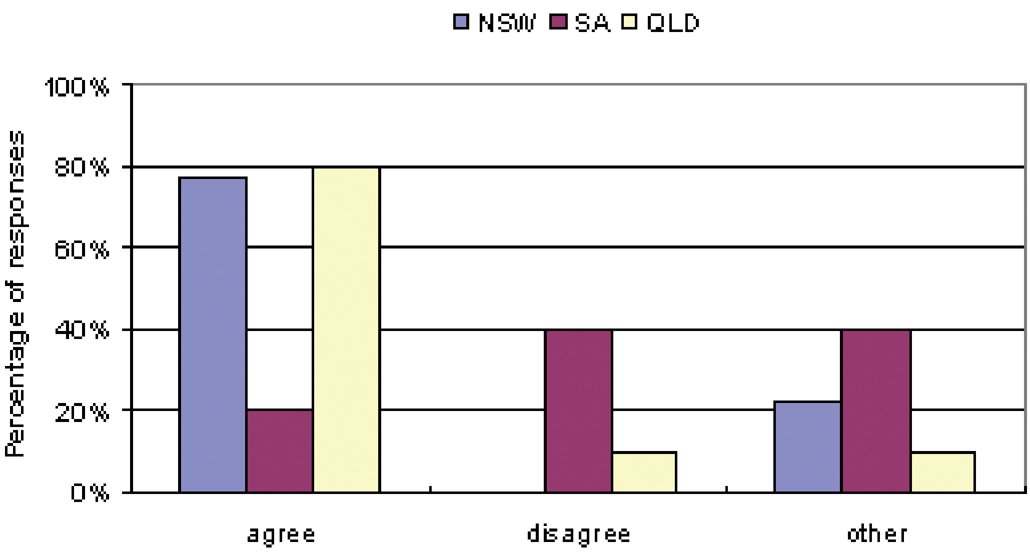


Figure 17. ‘In general, I would consider being involved in a tender for biodiversity management’

3.2 Perceptions of biodiversity

Like sustainability, biodiversity is an umbrella term for many interrelated issues with multiple dimensions. When ‘maintaining and enhancing biodiversity’ is used as an objective, there is a significant risk that the term could mask differences in views about the desired objectives and the required management. Different views between producers and ‘conservation representatives’ could lead to disagreement about the intent of contracts and problems in maintaining producer motivation. One concern is that producers’ livestock production interests could bias their views about the significant biodiversity values.

Overcoming this problem requires clear communication of the biodiversity values as seen by the purchaser (government). The workshops provided a limited opportunity to explore landholders’ perceptions of biodiversity values. A conceptual framework of biodiversity values was presented at two of the workshops, and participants were asked to what extent this framework reflected their views on biodiversity. Responses suggested that the framework was well understood and correlated well with producers’ views on biodiversity. The framework, by defining higher order goals and related management actions, also allows for adaptive management as more is learnt about the system. That is, the higher order objectives, such as maintaining resilience, should not change in response to greater knowledge about how biodiversity in the region functions.

In all workshops over 80% of respondents agreed with the statement ‘I understand what is meant by biodiversity.’ In NSW and QLD over 90% agreed with the statement ‘It is clear to me how management of my property affects biodiversity’. In the SA workshop this figure was 60%. One possible cause of the lower figure in the Stony Plains is that the biodiversity management issues appear more complex and less certain than in the other regions. That is, in the NSW and QLD workshops there was a strong focus on maintaining and improving vegetation cover, while discussion in the Stony Plains focused on a wider range of threats and biodiversity attributes.

The term ‘biodiversity’ appears to be commonly used and well enough understood to allow a tender for biodiversity to be meaningful. An ongoing dialogue to develop and obtain shared community views on what biodiversity is, and what biodiversity management goals should be, is an important element of biodiversity policy, especially given the importance of intrinsic motivation in biodiversity management. A tender mechanism, by focusing explicitly on tradeoffs and opportunity costs of public investment, both requires and can help stimulate this debate.

3.3 Motivation for participation in a tender

Nearly all participants agreed with the statement that the biodiversity in their region has inherent value (Figure 18), while at least half considered that there were risks to this biodiversity (Figure 19). Some who disagreed with this last statement commented that their answer was because they saw that they were already successfully managing the threats to biodiversity.

These results indicate awareness of, and value for, biodiversity. Pastoralists who attended the workshop are likely motivated to manage for biodiversity, so these results should not be extrapolated to the general population of producers. For the purpose of a tender however, where the aim is to focus on those with the capacity and motivation to contribute, the results indicate that there is significant intrinsic motivation, willingness, and a perceived need to manage biodiversity values.

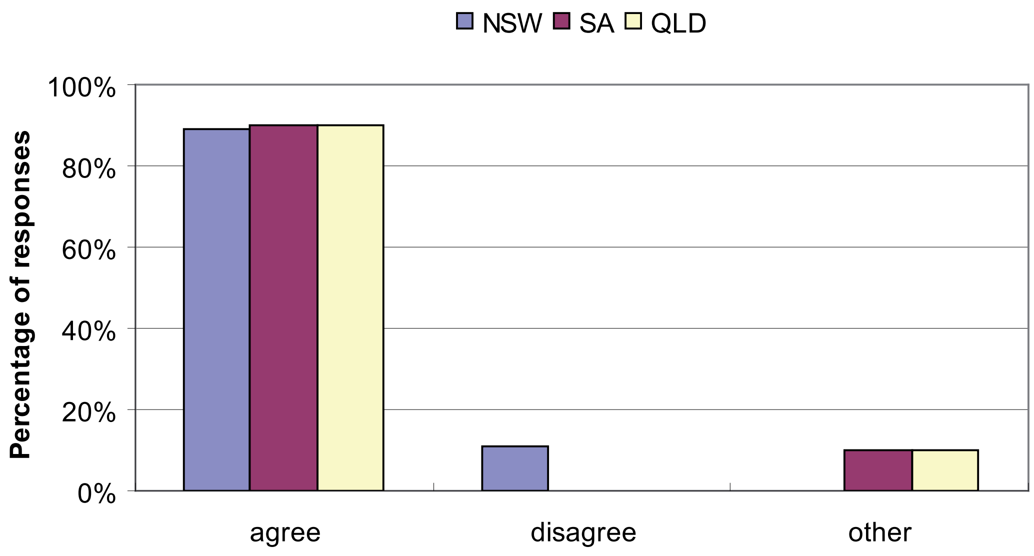


Figure 18. Responses to the statement: 'It is important to protect the biodiversity of the region for its own sake.'

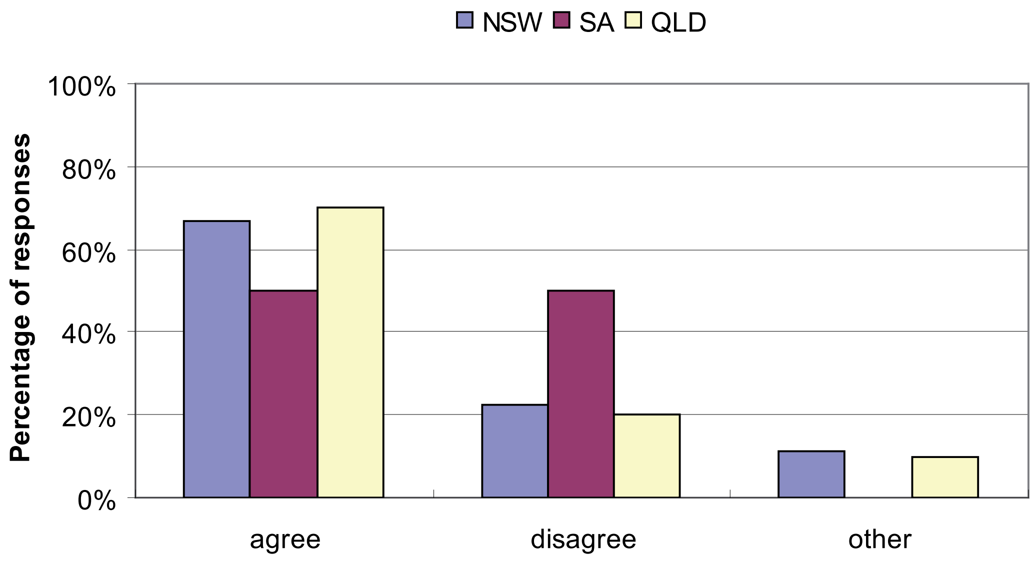


Figure 19. Responses to the statement: 'I am concerned about the risks to biodiversity on my property.'

Figure 20 indicates that achieving biodiversity outcomes is a factor in motivating participation in a tender. Anecdotally, the desire to manage biodiversity seems to be at least as significant a motivator for participation as the financial incentive. The importance of fostering and maintaining intrinsic motivation for biodiversity management is addressed in the discussion.

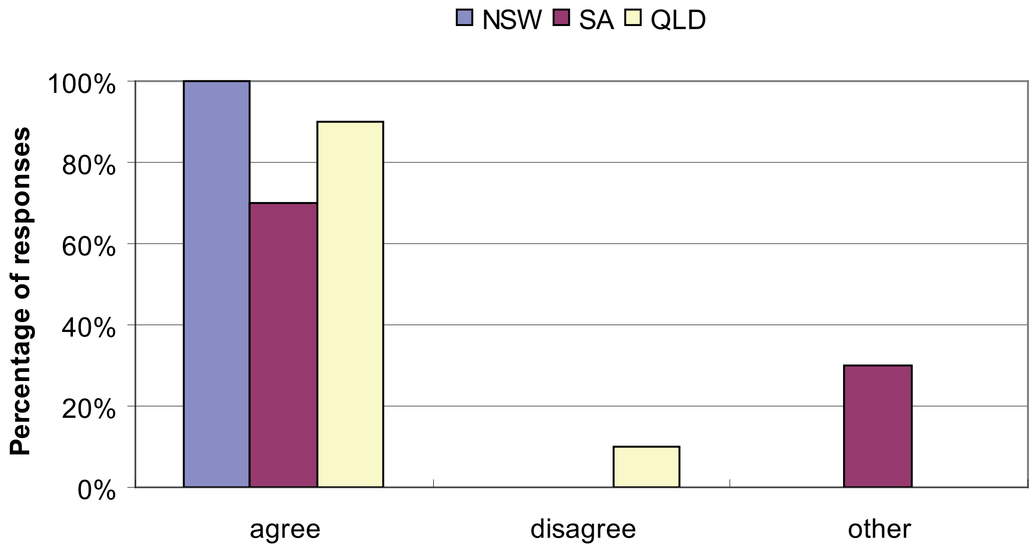


Figure 20: Reasons why I may participate in a tender include: An opportunity to improve biodiversity management.

3.4 Potential impediments to participation

A range of factors could prevent participation in a tender. The questionnaire focused on several possibilities, ranging from general institutional issues to specific tender design issues. The key questions related to:

- if government is seen as having a role to play in improving biodiversity outcomes in the region
- potential dislike of dealing with government
- concerns about government interference in management
- concerns about restrictions on stock management
- if a tender mechanism was viewed as a good way for government to help improve biodiversity
- if producers could think of ways to improve or maintain biodiversity that could make good tender submissions.

Government was seen as having a legitimate role in biodiversity management in all regions. Half of the Stony Plains respondents and a third of NSW and QLD respondents agreed that dislike of dealing with government may be a reason for not participating. However, this may be directed towards specific arms of government, as many respondents had a strong preference for who should run a tender. This was very dependent on the institutional history in the region.

Concerns about government interference in management (Figure 21) was the most significant impediment. This concern was lowest in Queensland. Recent vegetation management reform seems to have resolved rather than exacerbated concerns about further impositions. This result reflects the importance of clearly defined property rights in enabling markets.

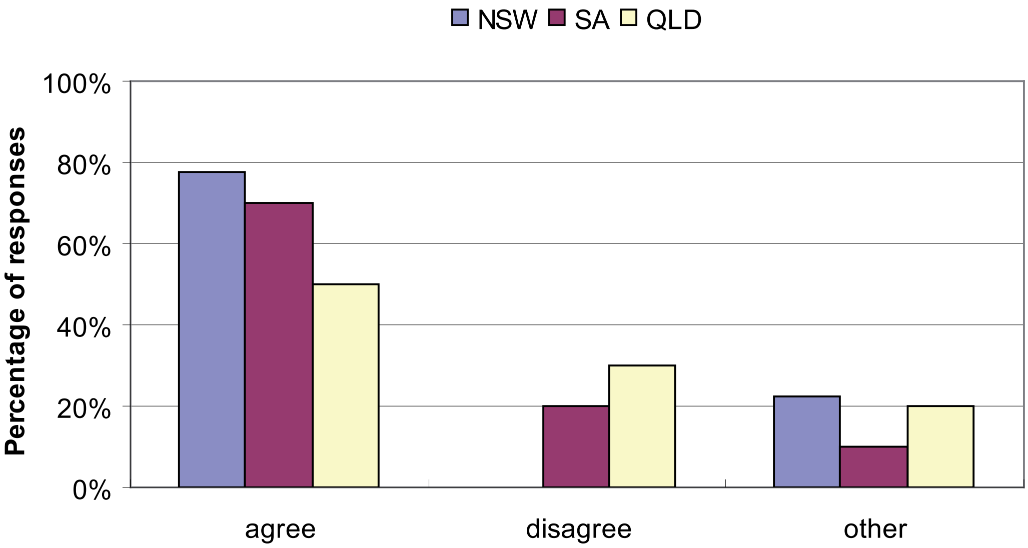


Figure 21: Reasons why I may not participate in a tender: Concerns about government interference in management.

Small-scale regional MBI projects seem to work despite this property rights uncertainty. For larger scale programs this may be more of an issue as the program may be viewed as playing a role in defining these rights. The concerns mentioned were both that the MBI policy process would lead to unknown and unspecified restrictions imposed in the future, and also that these restrictions would not in fact be beneficial to biodiversity. This result therefore also suggests the importance of credibility in ensuring participation. The credibility is a function of the credibility of the individuals and institutions managing the MBI, the scientific validity of the management actions, and the need to manage perverse incentives when designing contracts.

Approximately 80% of respondents from the NSW and QLD workshops agreed with the statement that: 'A tender mechanism is a good way for government to help improve biodiversity in the region.' This contrasts strongly with the Stony Plains where 90% disagreed with this statement. Reasons given for the disagreement in the Stony Plains were varied. One respondent mentioned the problem of fairness in funding only some of the bids in the region, especially when cooperative management of issues such as pests was required. Others doubted the ability and practicality of defining worthwhile contracts. Another reason given was that they saw other investment options, for instance stock transport rebates, as being preferable. Support for tender mechanisms where they have been trialled is a good indicator that they are viable. However the strong resistance to them in the Stony Plains, and the low response rates in some other biodiversity tenders (Comerford and Binney 2006) indicates that support is not guaranteed, and the process of introducing them is important.

One of the most significant issues for biodiversity tenders is the ability to specify meaningful contracts when the outcomes can only be imperfectly specified and monitored. One theme the workshops explored was the advantages and problems with a range of different contract options.

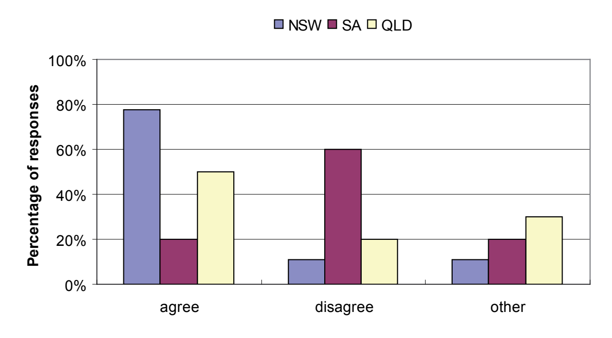
The implications of inefficient input measures, adverse selection, and various design issues that can provide perverse incentives or opportunities to subvert the intent of the scheme were generally identified and discussed by participants. The potential role of producers in helping to specify worthwhile contracts was discussed. In the questionnaire producers were asked if they agreed with the statement: 'I can think of ways to improve or maintain biodiversity that could make good tender submissions.' Over 70% of participants in NSW and Queensland and 50% of Stony Plains agreed with this statement. This result suggests a general opinion among producers that practical contracts can be defined. There was not consensus among producers about what these contracts could be.

3.5 Contract and tender design issues

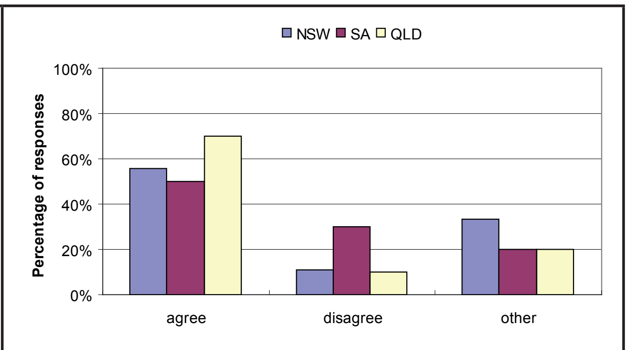
The specifics of a tender are important to effectiveness and acceptability. The questionnaire asked about four aspects of the tender and contract design:

- what management actions or biodiversity outcomes producers would be willing to use as the basis of contracts
- the preferred duration of contract and tender payment structure
- what organisations they would be prepared to enter tenders with
- how contracts would be assessed and monitored.

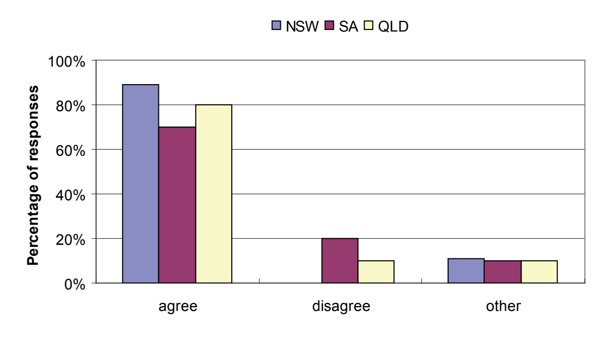
Figure 22 shows the willingness of respondents to enter into a tender where the contract specified different management actions or biodiversity outcomes. In NSW where a tender scheme has been operating that specifies a range of different management actions and outcomes, producers were generally prepared to consider all of the proposed contract options. In all regions contracts that specified weed and feral animal control or monitoring were acceptable to most producers. Contracts that specified significant management changes, such as stock restrictions or water point restrictions were less popular. This reflects concerns that the measures will restrict livestock production income. Contracts that specified the number of plant species or the vegetation condition were considered acceptable to less than 20% of Stony Plains producers. This result partly reflects concerns about the ability of management agencies to assess the impact of management on condition in a variable landscape. There were also difficulties in the workshop exercises in specifying a meaningful vegetation condition measure that was accepted by Stony Plains landholders.



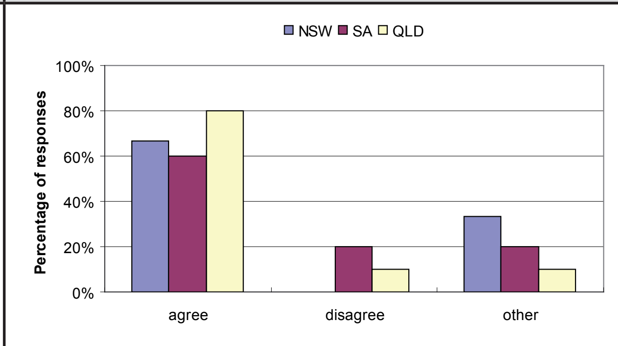
CLOSING OR LIMITING WATERING POINTS



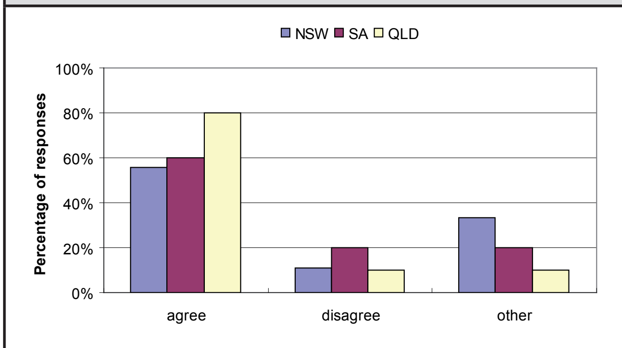
WEED MONITORING



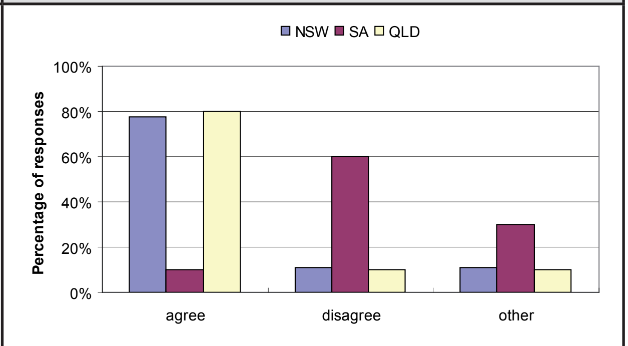
FERAL ANIMAL CONTROL ACTIONS



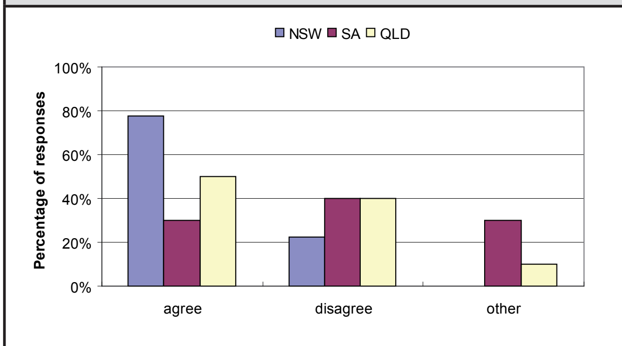
WEED CONTROL ACTIONS



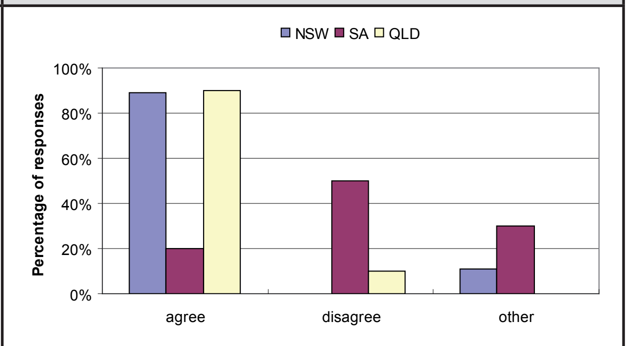
FERAL ANIMAL MONITORING



NUMBER OF PLANT SPECIES



STOCKING RATES



VEGETATION CONDITION

Figure 22: Questionnaire responses to the statement: 'I would consider a tender that specified ... (the given the management actions our outcomes).'

3.5.1 The preferred duration of contracts

Figure 23 shows the percentage of respondents that would consider contracts of various durations. The results are averaged across the three workshops. The results show no strong preference over duration, and a willingness by about one-third of respondents to consider permanent changes to the lease conditions.

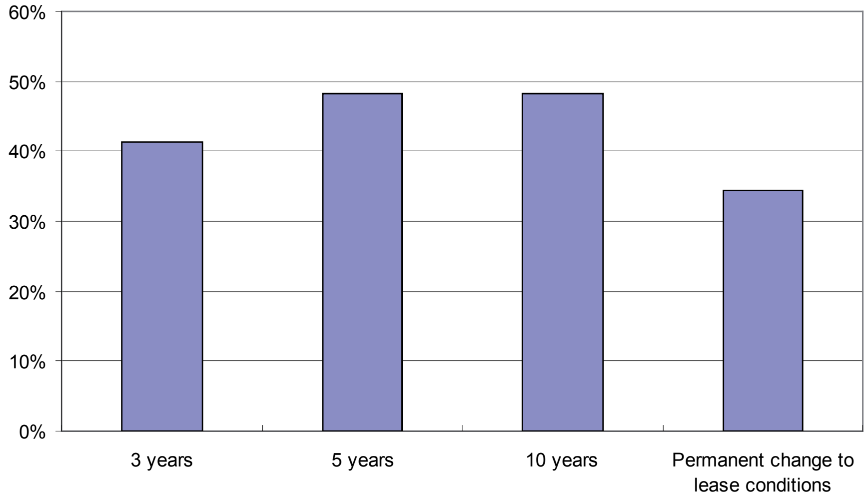


Figure 23: Percentage of respondents that would consider being involved in a tender with the specified contract duration

Figure 24 shows the preferred payment structure, and indicates a strong preference for annual payments, as opposed to payment at the completion of the contract. This is consistent with other results that indicate 60% of respondents consider a consistent annual income stream as being an important motivation for participation.

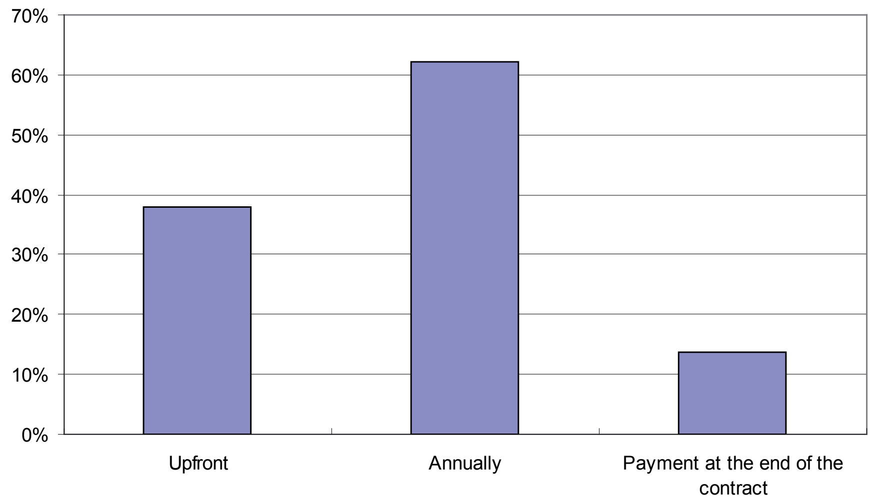


Figure 24. Percentage of respondents that would consider being involved in a tender with the specified contract payment structure

3.5.2 Preferred tendering organisations

There was significant variation across regions in preferences for who should conduct a tender. Much of this could be traced to previous experience and trust. For example, non-government organisations were acceptable to 70% of Queensland respondents, where they have a history of operating conservation programs, but were acceptable to only 30% of producers in the NSW workshop. The South Australian Arid Lands Natural Resource Management Board was the most acceptable provider in the case of South Australia, perhaps reflecting the long history of involvement of the organisation and individuals in lease assessments in the region. The federal government was acceptable to 80% of respondents in NSW and QLD. Acceptability of state government was dependent on which branch of government would be involved.

Building on local institutions increases the likelihood of participation and success.

3.5.3 Assessment methods

Questions about the acceptability of site visits and remote sensing were included in the questionnaire to assess if producers have privacy concerns related to a biodiversity MBI. That is, they may not wish to reveal the range of biodiversity assets on their property due to concerns about triggering restrictive legislation. While these concerns may be valid, they were not raised in the workshops. In fact, 80% of NSW and Qld respondents and 50% of SA respondents were happy with site visits as an assessment method. In discussion, workshop participants indicated that the use of remote sensing data by itself was not generally supported because of accuracy concerns among producers, but the use of remote sensing in conjunction with site visits was considered favourably. Indeed many producers indicated they would find access to the remote sensing data valuable in its own right, as a useful way to monitor their own management. This discussion indicated that using a remote sensing–based assessment as a starting point for a site visit, and emphasising the use of this information for adaptive management may be useful. Providing access to remote sensing data as part of site visits may be a useful way to support intrinsic motivation for improved management, and to extend it to parts of properties outside of the contract areas.

3.6 Perceptions of the relationship of production and biodiversity

Producers were asked if they agreed with the statement: ‘It is possible to manage biodiversity properly without affecting the financial viability of grazing’. Results are shown in Figure 25. They show that 80% of NSW and Qld respondents and 50% of SA respondents agreed with this statement. This result appears to be important in explaining different attitudes towards tenders. Specifically, Stony Plains producers see improved biodiversity management as requiring a reduction in grazing income and are concerned about tenders resulting in (uncompensated) government interference in management. These two results seem important in explaining the low support for tenders in the Stony Plains region. This is discussed in more detail below.

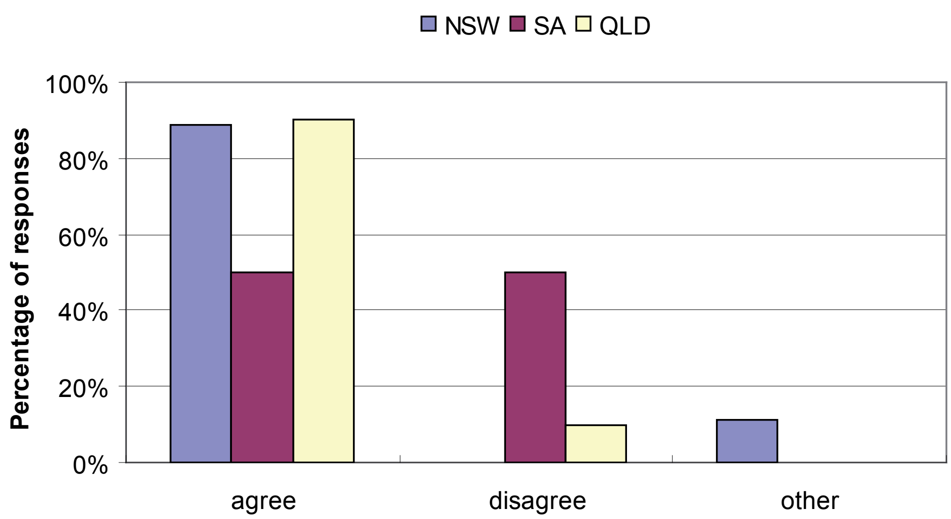


Figure 25. Response to the statement: ‘On my property, it is possible to manage biodiversity properly without affecting the financial viability of grazing.’

4. Discussion

The discussion begins by introducing a conceptual framework for analysing rangeland biodiversity policy. This framework is used to discuss integration of policy approaches, knowledge requirements for biodiversity tenders and perceptions of biodiversity tenders by pastoralists. The possible impacts of previous government NRM policies on stakeholder attitudes to a tender are also discussed.

4.1 A framework for analysing rangelands biodiversity policy

The motivation for this framework was that we observed widely differing views on what an appropriate rangeland biodiversity policy should be, and these differences appear to be based on different assumptions. The key assumption is the relationship between biodiversity and the sustainable level of production. Figure 26 is designed to help reconcile these different views and suggest criteria for selecting and mixing different policy approaches. The x-axis is the income that can be derived from livestock production activities while maintaining the ecosystem in a given condition. The y-axis indicates the biodiversity value of the landscape given this condition using an unspecified biodiversity metric. We conjecture that the possible steady state relationships lie roughly on a curve with the shape given in Figure 26.

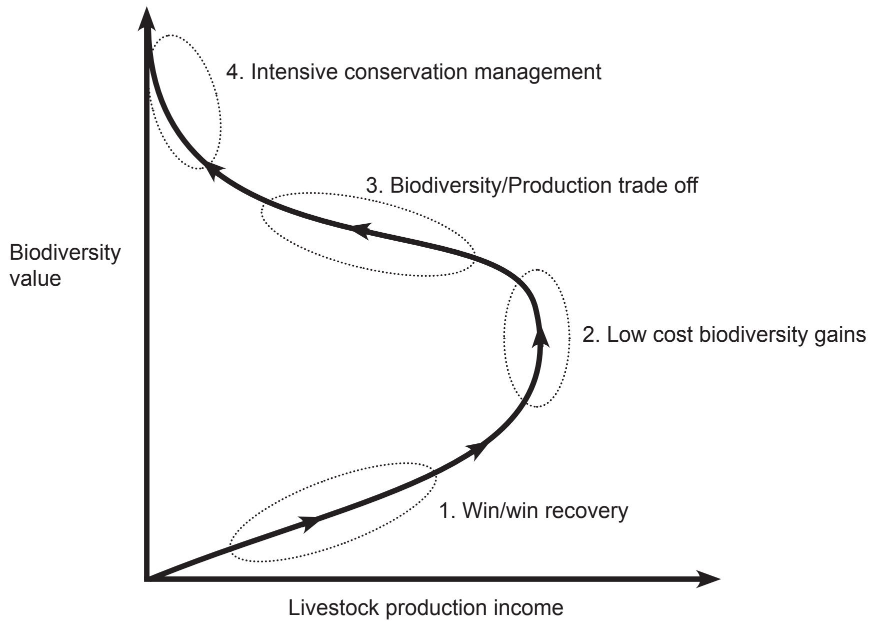


Figure 26. Overview of different stages in the relationship between biodiversity and grazing production

The curve defines four distinct states in the management of biodiversity.

State one describes overgrazed areas where recovery and restoring the natural vegetation biomass will result in increased productive capacity as well as an increase in the resilience of the system. The increase in resilience of the functioning of the system can be considered as a biodiversity benefit.

State two describes an area which is managed at something close to a maximum sustainable yield. Increases in biodiversity outcomes in this state can be achieved with minimal or no cost to production. For instance, this may be achieved by a focus on controlling threats to biodiversity other than production, such as feral predators and weeds, or simply by improving stock management at critical times for biodiversity.

State three: In this state improvements in biodiversity come at the expense of grazing production. This may include reduced stocking rates, spelling paddocks from grazing, or other grazing regimes that produce less grazing income. Note that other management actions besides destocking may be required during this phase.

State four: In this state, the impact of grazing on biodiversity has been eliminated and further improvements need management of other threats. This phase differs from states two and three in that the management actions required are either more expensive than removing stock, or are only effective once grazing has been (for the most part) removed.[1]

Note that the relative size of changes in biodiversity and production in state may vary across regions. In addition, the ability of a given area of land to achieve a certain biodiversity condition may be limited by starting condition. The analysis can also be applied at different scales, but at large scales the implications of variable condition across the landscape need to be considered.

4.1.1 Designing policy

Figure 26 provides a framework for discussing policy options and reconciling divergent views on how biodiversity conservation and livestock production should be mixed.

First note that efficient or preferred combinations of production and biodiversity will be those higher and further right in Figure 26. For a given region the best state to be in will depend on the weight or value given to biodiversity relative to production income, and on the shape of the curve (that is, the relative biodiversity production trade-off that exists). Depending on these factors, the efficient outcome could be in state four, state three or at the top of state two. Given the spatial variability in production and biodiversity values, an efficient biodiversity-production balance for a region may require a mix of areas in all these states.

Policy design therefore requires addressing two issues. First: we must estimate the shape of the curve, and as a result predict the state or states that are likely to be appropriate within a region. Second: we must design a policy that is suitable for the relevant states. In general, different states will require different policy approaches.

4.1.2 Knowledge requirements for policy choice and prioritising areas

Determining which state is relevant for a given area requires two streams of work: the development of a biodiversity index, and an assessment of the production income associated with each state. That is, a biodiversity assessment and an economic assessment is required to inform the appropriate biodiversity and production mix.

A complication of the economic assessment is that knowledge about the relative costs and benefits of production are held privately by producers. One role for a trial MBI can be to help reveal these values and therefore identify the relevant trade-off zones for a region.

1 Note that this stage does not imply that destocking alone will result in substantial biodiversity gains. Rather, destocking plus appropriate biodiversity management is required. Showing the level of biodiversity management in Figure 26 would require an extra dimension. The biodiversity management action in each phase is considered to be optimal, generally increasing in intensity with higher levels of biodiversity outcomes.

4.1.3 Integration of policy approaches

A focus on different states of the biodiversity production trade-off requires different policy approaches. Some policy implications of focusing on each state are as follows:

In state one the interests of grazing and biodiversity are strongly aligned. A continuing payment for biodiversity outcomes in this state should not be required, as it is in the best production interests to move to state two. Policy could focus on either assistance to move to state two, or enforcing a duty of care that requires the system to be run at a more productive and more biodiverse state. Underlying reasons for why an area came to be in the degraded state also need to be addressed. One-off market-based incentives could be a useful tool to stimulate and accelerate these mutually beneficial changes.

If state two is most important, then an education and engagement program to promote biodiversity-friendly grazing practices, perhaps backed by moderate adjustment incentives, is likely to be most effective. Again, ongoing payments for biodiversity outcome should not be required.

State three represents the trade-off zone. In this state biodiversity improvements can only be efficiently obtained at the cost of lost production. Figure 27, below, illustrates what the biodiversity/production trade-off might look like in an area where this state is most important. If this is the case, then achieving reduced grazing will require ongoing incentives or regulation.

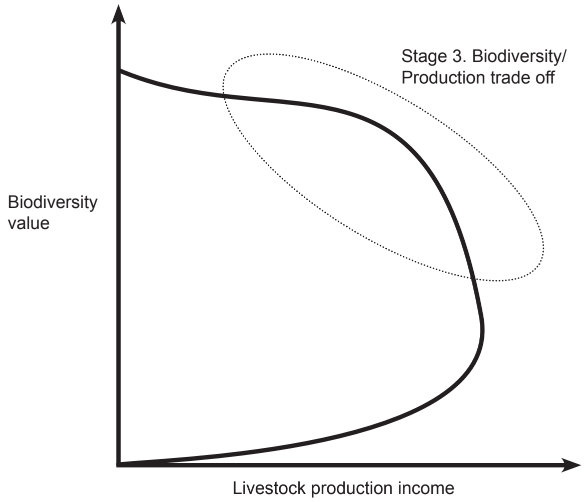


Figure 27. Biodiversity conservation- livestock production relationship where the trade-off zone dominates

Finally, if state four benefits dominate, it will be difficult to achieve significant biodiversity benefits without destocking. Destocking plus investment in biodiversity management is required.

This analysis implies a range of policy approaches may be valuable either alone or in combination depending on the trade-offs facing managers. When designing policy, it is important to correctly diagnosis what state or states are relevant. As an example of the problem of incorrect diagnosis, a one-off adjustment policy, such as payment to temporarily reduce stocking pressure may be appropriate in state one. However if the area is in fact in state three, then the financial incentive to increase stocking pressure will cause the biodiversity gains to be lost over time. Alternatively while education, and awareness policies may be the appropriate focus in state two, they will be ineffective by themselves in state three.

4.1.4 Stocking levels and management for biodiversity outcomes

This framework can also be used to address the issue of the extent to which a given total grazing pressure should be concentrated or spread across the landscape to achieve the best overall biodiversity outcome. The choice appears to be crucial for policy design as each choice has significant implications for the required design and implementation of the system. For instance, monitoring of destocked area is likely to be easier, but motivation for producers to undertake other management activities on this land may then be reduced. As discussed above, the choice will be influenced by the relative biodiversity benefits obtained in states two, three and four. Specifically, if there are significant benefits from state four, and the relative value on biodiversity compared with income is high, then dedicated biodiversity reserves are likely to be most efficient. Alternatively if state two and three biodiversity benefits dominate, then managing land for mixed production and biodiversity outcomes makes sense.

4.1.5 Production-biodiversity states and producer views on market-based instruments.

Anecdotally, the perception of the relative importance of the different states seems to explain different policy stances in different regions. For instance, the NSW workshop seems to indicate a system in state one with a strong interest in using managed grazing to improve ground cover and therefore biodiversity and production outcomes. While there is strong support in the region for incentive payments, this diagnosis suggests that either adjustment incentives, and/or enforcement of duty of care standards may be more appropriate for most of these areas. Adjustment incentives can be effectively allocated via MBIs.

The views of pastoralists in the Stony Plains workshop appears to be of a system generally in stage two. They see the value of increased assistance to manage the system with the current level of stock production. In addition, the see destocking without significant investment in other management controls as having minimal value, that is, they see little biodiversity benefits in stage three. This perception may explain the lack of support for an incentive-based approach in this region.

4.2 Attitudes to income from government payments

We may expect producers to view income from biodiversity management as equivalent to income from other enterprises on their property. But a history of government NRM and biodiversity schemes appears to have generated a set of ethical and behavioural norms related to government biodiversity payments that may, at least initially influence the way in which producers respond to a tender. For instance, payments for biodiversity or NRM work typically pay for materials and expect the producer to provide the required labour and ongoing management. There is also an expectation that the grant schemes are accessible to all. A tender scheme that allows compensation for management time, speculative profit, competition, and which may not require management change, may therefore cause confusion and resentment towards the tender program. Initial consultation will be required to address this issue.

Uncertainty about the permanency of the scheme is also likely to influence attitudes towards payments from government. Both these factors may decrease participation rates and intrinsic motivation for good biodiversity management if not addressed.

5. Recommendations

This section provides recommendation for the use of market-based instruments in the rangelands. They are based on Part 1 of this report and the above workshop results and discussion. We begin with general, and end with specific recommendations. The recommendations are by no means a complete formula for policy development. We emphasise the need for a regional, collaborative and adaptive approach to policy development.

5.1 A best-bet policy approach

This section describes the key elements of the preferred policy approach, starting with a summary of the key arguments for this position. This is based on the public good nature of the problem and the property rights surrounding biodiversity on the rangelands.

5.1.1 The public good nature of biodiversity conservation benefits.

The benefits of biodiversity conservation on rangelands accrue to the general public. Its value to the general public will not be fully expressed in a market because the value of biodiversity is not reduced by consumption and because of the inability to exclude people who do not pay from enjoying biodiversity outcomes. Some private philanthropy organisations are acting to express some of the public value for biodiversity as effective demand. However, there is still likely to be a significant market failure to be addressed. Therefore, government has a role to provide biodiversity conservation on behalf of the public. Facilitative approaches to policy are unlikely to provide sufficient incentives for conservation as they do not address this fundamental failure to effectively express the value for conservation as incentives for biodiversity management. Regulatory and/or market-based approaches are therefore required.

5.1.2 Property rights

The rights and responsibilities surrounding biodiversity management on rangelands are unclear. This is a result of the concept of biodiversity being difficult to define clearly and the fact that it is an emerging issue. Definitions of rights in rangelands under leasehold tenure are under review, but this is beyond the scope of this study. For practical purposes, any market-based approach must be able to work with some uncertainty about the definition of rights and responsibilities surrounding biodiversity conservation. While this is a matter of degree, the complexity of defining clear property rights for biodiversity conservation in rangelands rules out the practical use of a quantity, or cap and trade approach to policy, at least in the immediate future. In general, a cap and trade approach requires a clear definition of the initial allocation of biodiversity rights for all potential traders, and a simple measure of what is traded. Alternatively, a price-based auction or tender mechanism where the government acts as sole purchaser allows a less explicit definition of rights, and the ability to use more complex and flexible criteria in determining the relative values of different biodiversity options.

A price-based tender approach, where the government acts as a purchaser of biodiversity outcomes, and the price is determined by selection of competing bids from potential participants, is the most likely to be successful in the rangelands.

A range of possible options exist within this approach. These are discussed below.

5.1.3 What to purchase

It is necessary to clarify rights and responsibilities surrounding biodiversity management before it can be usefully traded. There are three important dimensions to the problem of specifying what is traded.

a. Temporary *or* permanent purchases (permanent purchases are transfers of property rights)
b. Purchase of management actions *or* purchase of biodiversity outcomes
c. A change from existing performance *or* a specified level of performance (of either biodiversity outcomes or management).

Ideally a scheme would choose the second option in each case. That is, it would pay for property rights, rather than temporary changes, for biodiversity outcomes rather than management actions, and for a specified level of performance rather than a change from current performance.

By a level of performance, we mean that a contract is based on an absolute standard being achieved, and that this level is maintained over time. Examples of a level would include a specified stocking rate or a given biodiversity index measure. If a change is purchased, then it is defined relative to expected ‘business as usual’ future management, for instance, construction of an additional fence. Purchasing a change may indirectly result in other management activities changing, for instance by freeing up management time or financial capital that is then invested into other areas of the property.

There are pragmatic reasons for choosing temporary changes, at least initially, and given metric and monitoring uncertainties, combinations of management actions and outcomes can be used. However, uncertain property rights have also resulted in the purchase of performance changes rather than specified levels becoming standard practice. If a scheme is to efficiently achieve biodiversity outcomes it should focus on purchasing specified levels rather than changes in biodiversity management and outcomes.

If the overall aim of the scheme is to maintain a relatively intact ecosystem, and it is accepted that it is generally easier cheaper and less risky to maintain than improve rangelands biodiversity outcomes, then the focus of a scheme should be to maintain existing good condition regions. This may involve changing management, but will most likely focus on guaranteeing continuation of current management practices for high quality, high value sites.

An important implication of an outcome-based scheme is that that we may not see any significant change in management or biodiversity outcomes (relative to current conditions). However the current biodiversity management is ensured against future decline and threats that can reasonably be expected to occur if nothing is done.

The alternative approach, to purchase changes in management actions, would likely result in an improvement and measurable change on areas that the scheme focuses on. However, the continued good management of current high biodiversity value sites is not assured. If management better than the current standard is desired, then it is recommended that existing good practices are locked in first.

The distinction between these approaches appears to be implicitly well understood by pastoralists. The purpose of the scheme needs to be made clear, as there is understandable confusion among pastoralists about what the implied level of duty of care would be, and therefore if well managed sites would be eligible. The practice of many existing schemes is to subsidise management changes (e.g. paying for fencing materials) and this has lead to acceptance of this kind of approach. This can cause some reluctance to offer existing well managed sites to a tender that do not require changes in planned management. It is also understandably confusing to a pastoralist as to why they should sell something that involves no change to planned management.

Paying to maintain existing good biodiversity management or outcomes is recommended.

Such a scheme may not lead to any improvement in biodiversity outcomes relative to the current standard, however it will help ensure good biodiversity outcomes into the future.

If a scheme wishes to purchase biodiversity outcomes, this may need to be carefully communicated as a history of purchasing changes to management actions, and confusion over government objectives may prevent well managed high value sites from being offered.

5.1.4 Objective of the MBI

There is a range of benefits from using markets to allocate resources that MBIs attempt to capture. However there are practical limitations to what can be achieved, and the design process needs to identify and focus on the main achievable benefits.

For rangeland biodiversity conservation the key benefits of a tender approach, when compared with a fixed price grant scheme, are achieved by taking advantage of the private information held by pastoralists about their relative costs of achieving biodiversity outcomes in a heterogeneous environment.

Heterogeneity exists in the biophysical system, economic circumstances, and the personal values and willingness of individuals to participate. A tender mechanism can effectively identify where these factors line up, creating high value opportunities for efficient conservation.

The key objective of a tender mechanism is to identify significant and cost-effective options for biodiversity conservation.[2]

A secondary advantage of an MBI is that it focuses the objectives of the program by defining them in the form of a biodiversity metric that permits comparisons of value between bids. Defining and communicating clear biodiversity objectives that are linked to readily observable and measurable biophysical characteristics and management actions may help pastoralists formulate practical and effective biodiversity management plans.

5.1.5 Key contract options

Having identified areas and pastoralists that present opportunities for high value biodiversity management, a tender program must specify a contract that details the desired biodiversity management and/or outcomes. Given the complexities and dimensions of biodiversity, these contracts will not be complete. But since intrinsic motivation for biodiversity management is likely to be high, contracts that focus on removing or reducing financial incentives for competing uses and/or specify key elements of biodiversity outcomes, are likely to be sufficient. Feasible options include:

2 That is, the value does not necessarily lie in exchanging an ironclad contract. A good analogy is the job market. Having agreed on the price, the general terms of employment, and the general purpose of the job, the focus shifts to a partnership trying to achieve the desired work outcomes, and these can be renegotiated. Similarly, if the tenderers' have high intrinsic motivation to maintain biodiversity, then a robust legal contract may not be necessary. Future employment prospects also provide a significant part of a employee's work motivation. Similarly, producers should be motivated to develop credibility as a biodiversity manager if they are interested in securing long-term payments.

1. Stocking rates and destocking of paddocks or areas: In some regions, an input-based contract, such as stocking rates, is likely to be a useful and accepted approach. In other areas, restricting stocking rates is likely to be inefficient from both a biodiversity and production perspective.
2. Metrics based on vegetation cover data derived from remote sensing and local collection: Specifics of these need to be trialled further. In early stages, contracts based on simple measures such as ground cover can be used (together with restrictions on the use of introduced species such as buffel grass). In later stages more sophisticated metrics and measures can be trialled. In early stages, a combination of management specifications and outcomes is likely to be of value. For instance, in one example from the Enterprise Based Conservation scheme (Shepherd 2006), payment was based on percentage ground cover. However, the contract specified that if the required cover was not achieved, the pastoralist would still be eligible for payment if they had destocked below a pre-specified level.

   In general, simple input- and output-based contracts appear sufficiently robust to form the basis of a tender scheme. More sophisticated output measures and contracting options should evolve with use, increasing the flexibility for pastoralists, and decreasing the cost of compliance.
3. Pest animal control, while not addressed explicitly in this study, is likely to be a worthwhile area for tender-based approaches in order to target control effectively. Key issues include coordination across leases (and other tenure boundaries such as national parks), and the focus of control (biodiversity or pasture production). A pest control tender can be carried out as a separate program to the above, but caution is needed if both activities are needed on the same site to achieve biodiversity outcomes. Further work is required to develop and trial suitable mechanisms. For instance, the need for coordination across land holders may decrease the competitive nature of bids. Pre-approval of pest control expenses may be necessary to allow appropriate timely and targeted control actions.

5.2 Critical issues and risks for a tender based approach

5.2.1 Support intrinsic motivation for biodiversity management

A significant risk of any formal biodiversity policy is that it will undo much of the existing work that is done informally to maintain biodiversity. Anecdotally, this intrinsically motivated management is important in the rangelands.

The risk is that a program may not achieve a significant improvement, and it may reduce the motivation of pastoralists to maintain the level of biodiversity management they currently have. This risk is important in the rangelands for several reasons. Pastoral leases appear to have a relatively low turnover of ownership, there are few owners and the leases are over large areas. The motivation of any given lease holder is therefore relatively significant. In addition, pastoral leases on average have a low management input. As a result, many areas that maintain high biodiversity values are likely to do so because of a mix of benign neglect and intrinsic motivation; they are underdeveloped because management effort is focused elsewhere. This management system may be relatively fragile once managers start to evaluate options for using the land. Finally, given the difficulty of monitoring and the short-term incentives that exist to overgraze an area, areas of high biodiversity values may be relatively vulnerable.

A tender system needs to build on intrinsic motivations if it is to achieve outcomes in a cost-effective manner. This is because of the difficulty of monitoring, and the need to maintain a collaborative and adaptive approach to the management of biodiversity.

Supporting intrinsic motivation requires:

- Clear and consistent signals of governments' desired biodiversity outcomes. This requires coordination and consistency in the broader rangelands policy environment. To gain support from regional communities, a MBI must be seen as a logical part of an NRM and biodiversity management policy. There is a need to define how a biodiversity tender relates to other biodiversity conservation policies and programs that exist in a region.
- Acknowledgement and support for existing biodiversity management activities throughout, especially through site visits.

It is unclear exactly what actions may reduce intrinsic motivation. Given this uncertainty, managing it should be seen as a risk management exercise. Diversification (running regionally-based tenders) and trialling schemes are two recommended risk management strategies.

Site visits are a vital part of a tender process, as they enable acknowledgement and support for existing biodiversity management activities.

5.2.2 A coordinated and consistent rangelands policy environment

A coordinated and consistent rangelands policy environment is important because of its potential influence on intrinsic motivation for biodiversity conservation, and potential limitations on biodiversity management imposed by other schemes. There is also a need to define the role that a tender plays in the broader biodiversity conservation policy scheme, and how it relates to sustainability policy.

Key elements of this consistency include:

- building on existing institutions
- relationship with sustainability
- integration with national parks
- processes for coordination with other policies.

5.2.3 Build on existing institutions

The relationship between the tender operators and the pastoralists is important. These relationships take time to develop and therefore, where possible, should build on existing successful relationships. This may involve building on projects that were not initially focused on biodiversity.

5.2.4 Relationship with sustainability

The distinction between biodiversity and sustainable production, while important from a public policy perspective, can result in mixed messages being sent to pastoralists. Partnerships with production focused agencies should be considered in order to avoid duplication of efforts and help resolve and ensure duty of care conditions are met.

5.2.5 National parks

There is a widespread perception that national parks in rangelands are poorly managed. Issues cited included inadequate pest control, inadequate fencing, and inability to close watering points on national park land. These issues cause cynicism about governments' commitment to biodiversity conservation in pastoral areas. Investment in good management of national parks should be considered as an integrated part of rangeland biodiversity investment. This perceived failing poses a risk to the effectiveness of a tender-based scheme.

There appears to be little sense of engagement or interest in the national parks by pastoralists. There is potential to engage surrounding pastoralists in the effective management of national parks. One opportunity is to engage surrounding landholders in coordinated and mutually beneficial pest control.

5.2.6 Mixing with other biodiversity policies

Other biodiversity policies have the potential to conflict with an incentive scheme in unforeseeable ways. For example, coordination with the kangaroo harvest may be necessary for some proposed tender plans to be successful. Pathways need to be established that enable these issues to be effectively resolved.

5.2.7 Communication and language issues

Sensitivities around property rights and potential conflicts with other NRM policies make communication of the role of a tender scheme important. For instance in the Stony Plain region, a heading of ‘Rewards for biodiversity’ appeared to provide a more acceptable message than a tender scheme. Again, this needs to be addressed at a regional scale.

5.3 Conditions for an effective tender system: biodiversity tender design recommendations

This section discusses some of the key elements of a successful tender system that have been identified during this project. They include:

- acceptable participation rates
- region based
- starting small
- significant funding
- long time frame
- flexible specifications
- clearly defined objectives
- need for whole of lease contracts
- minimising transaction and monitoring costs for all parties.

5.3.1 Acceptable participation rates

Reasonably high participation rates are required to ensure the market is competitive. More significantly, unnecessary barriers to participation need to be eliminated to ensure that the potentially high value bids are in fact offered.

Participation rates will be affected by the potential and expected value of being involved. This depends on a reasonable chance of success in the tender, and a reasonably sized payout.

Other factors that are likely to influence participation include intrinsic motivation for biodiversity conservation, and the impact of other biodiversity and land management policies. Specifically, the participants may need to believe that the scheme is a useful and effective way to generate biodiversity benefits.

Addressing the issues below is likely to increase the likelihood of adequate participation rates.

5.3.2 Region-based schemes

Regions differ in many ways, and the need for regional NRM is well recognised. Institutional differences among states, and in the required and desirable management actions in different regions are two of the key reasons for recommending a regional approach.

A national- or state-based scheme may have value, particularly for identifying high value bids in regions that are otherwise unsuitable for a tender. Coordination with regional based systems, and the risks of a high profile large scale tender would need to be explored further before recommending this approach.

5.3.3 Starting small

Starting with smaller regionally based schemes is recommended for several reasons. First, there is real need for adaptive management in rangeland biodiversity, as it is a relatively new focus and our knowledge of how to measure it and how management actions affect it will improve rapidly.

Second, the risks of crowding out existing biodiversity management are reduced if a scheme is restricted to one region, and starts by working with the highly motived early adopters.

5.3.4 Significant funding

While schemes should start small, significant funding is required to make the scheme worthwhile. The size of the scheme must eventually be large enough (and well-funded enough) so the potential benefits from purchased management outweigh the potential risks to biodiversity from decreased intrinsic motivation.

5.3.5 Long-term funding commitment

A reasonably long-term contract (at least 5–10 years) is required for several reasons. Due to variability in the system, some management actions (such as destocking after rain) are only sensible on some occasions. Similarly, there may not be a response to changed management if seasonal conditions are not conducive. The benefits of short-term contracts are also less likely to cover the start-up costs and time of pastoralists' involvement in the scheme. In addition, there is real risk of damaging land managers' intrinsic motivation to conserve biodiversity if funding for programs is cut arbitrarily. Generally, pastoralists are aware that biodiversity conservation only makes sense if there is an ongoing commitment. A cut to a program would therefore signal a lack of real government commitment. In addition, a short-term program would effectively be paying a pastoralists to rest a paddock, and there would be a strong financial incentive to graze an area where the condition has improved after resting.

Combined, these effects mean there is a real risk that any benefits from a short-term program would be undone, and existing privately motivated biodiversity management may also be damaged.

Medium term (5–10 year) contracts are recommended in the initial stages of the program. This is to minimise the risk associated with permanent contracts, and allow more refined contracts to be implemented on a rolling or permanent basis. This timeframe allows producers to learn about the costs and benefits to them of participation, reducing uncertainty that would otherwise inflate the prices for permanent change.

5.3.6 Flexible specifications

Heterogeneity in ecosystems, people and production systems creates variability in the cost of managing for biodiversity that market-based instruments target in order to generate outcomes efficiently. However, heterogeneity also generates variation in required and efficient biodiversity management. Flexibility in specifying what outcomes are achieved and what management actions are needed to achieve them is therefore required. This is best assessed at a regional scale.

5.3.7 Clearly defined objectives

This has two elements. The first – whether a management change or biodiversity outcome is desired – has been addressed above. A second issue is to ensure that what is meant by biodiversity outcomes is generally and consistently understood.

This is important in allowing the pastoralists to understand what is required and to formulate bids and management plans that are effective and aligned with their production management goals. Having clearly defined objects may also help clarify pastoralists' intrinsic biodiversity management objectives. The regional process of jointly defining biodiversity goals is therefore an important part of a region's capacity to run effective biodiversity tenders.

Most workshop participants felt they understood what was meant by biodiversity, and how management affects biodiversity. The extent to which these views correlate with those of ecologists and government needs to be explored further. Important variances in opinion on biodiversity objectives may lead to differing views on appropriate management. An important role for higher levels of government is likely to be to ensure that biodiversity outcomes for region-level schemes are defined in a way that is consistent with government objectives.

5.3.8 Whole of lease contracts

It is relatively easy to reallocate grazing pressure and management effort from one area of a property to another. Contracts that cover only part of the property may therefore have adverse effects on biodiversity on other parts of the property. Even when the focus for biodiversity management is only on a particular part of the lease, there is a need to stipulate management conditions across the lease. In the absence of a suitable metric for this requirement, it could be expressed as a duty of care level that covers the remainder of the property.

This issue is more important in rangelands than in cropping areas. In cropping areas there is a focus on remnants rather than whole of landscape biodiversity, and management effort and other resources diverted from conservation areas in agricultural landscapes are likely to be focused on other areas that are already cleared (and consequentially with lower impact on native vegetation and biodiversity).

Whole of lease contracts are complex and risk reducing intrinsic motivation for biodiversity management. But an effective tender will require this issue of slippage to be addressed in the medium term.

5.3.9 Minimising transaction and monitoring costs for all parties

Managers' time is a finite resource. In some cases it was a limiting factor in engagement in a tender process. It is therefore important to limit the engagement and contracting costs of the programs.

5.4 Other opportunities for markets in the rangelands

5.4.1 To encourage adoption and trialling of new practices

A tender system may provide effective incentives to pastoralists to trial new risky and/or expensive technologies and management systems. These may have significant biodiversity benefits, to the extent that they are linked to production benefits.

5.4.2 As a way to derive biodiversity benefits from drought relief

A tender system could offer a form of drought insurance. That is, it could provide for income support in exchange for reducing stocking pressure during times of drought stress. There may be significant benefits in negotiating contracts that are specified ahead of times. Such a contract could also be triggered by either party. For example it could enable government to exercise a compulsory (and compensated) destocking order during drought, and/or enable the pastoralist to claim drought relief, subject to destocking. Other requirements and built in triggers are possible. A key feature is a pre-commitment to a mutually agreed contract and price.

6. References

Comerford E and Binney J 2006, 'Lessons learned from the Queensland Vegetation Incentives Program: applying auction theory to vegetation protection', Paper Presented at the 50th *Australian Agricultural and Resource Economics Society Conference*, Sydney.

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Appendix 1: Biodiversity Incentives Workshop

Appendix 1: Biodiversity Incentives Workshop

August 2006

Questionnaire

The questionnaire aims to identify issues for using biodiversity tender in Rangelands.

Responses to the survey will be kept strictly confidential. *The data will be collected and handled only by CSIRO.*

Feedback on possible tender designs.

Please indicate the extent to which you agree or disagree with each statement by circling the most appropriate answer

1 = Strongly Disagree 2 = Disagree 3 = Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree

In general, I would consider being involved in a tender for biodiversity management	1	2	3	4	5
I would consider a tender that specified:					
o Stocking rates	1	2	3	4	5
o Closing or limiting watering points	1	2	3	4	5
o Feral animal control actions	1	2	3	4	5
o Feral animal monitoring	1	2	3	4	5
o Weed control actions	1	2	3	4	5
o Weed monitoring	1	2	3	4	5
o Vegetation condition	1	2	3	4	5
o Number of plant species	1	2	3	4	5
I would consider a tender run by:					
o Federal government	1	2	3	4	5
o State government	1	2	3	4	5
o A non government organisation (eg: Greening Australia or World Wildlife Fund)	1	2	3	4	5
I would consider a tender that involved payment:					
o Upfront	1	2	3	4	5
o Annually	1	2	3	4	5
o Payment at the end of the contract	1	2	3	4	5
o A mixed payment schedule (e.g. 50% upfront and 50% as annual payments)	1	2	3	4	5

Feedback tender design ....continued.

Please indicate the extent to which you agree or disagree with each statement by circling the most appropriate answer

1 = Strongly Disagree 2 = Disagree 3 = Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree

I would consider a tender that lasted for:					
o 3 years	1	2	3	4	5
o 5 years	1	2	3	4	5
o 10 years	1	2	3	4	5
o Permanent change to lease conditions	1	2	3	4	5
I would consider a tender where assessment of biodiversity outcomes and management was by					
o Site visits	1	2	3	4	5
o Site visits that are combined with remote sensing	1	2	3	4	5
o Remote sensing	1	2	3	4	5
Reasons why I may participate in a tender include					
o Additional income	1	2	3	4	5
o A reliable annual income stream	1	2	3	4	5
o A opportunity to improve biodiversity management	1	2	3	4	5
Reasons why I may **not** *participate in a tender include*					
o Time required to submit tender	1	2	3	4	5
o Paper work	1	2	3	4	5
o Time required for extra management	1	2	3	4	5
o Site visits, even if prearranged	1	2	3	4	5
o Restrictions on stock management	1	2	3	4	5
o Dislike dealing with government	1	2	3	4	5
o Concerns about government interference in management	1	2	3	4	5

Management issues for the Region

Please indicate the extent to which you agree or disagree with each statement by circling the most appropriate answer

1 = Strongly Disagree 2 = Disagree 3 = Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree

I am concerned about the risks to biodiversity in **the region.**	1	2	3	4	5
I am concerned about the risks to biodiversity **on my property.**	1	2	3	4	5
I am concerned about the long term sustainability of livestock grazing on my property.	1	2	3	4	5
On my property, it is possible to manage biodiversity properly without affecting the financial viability of grazing.	1	2	3	4	5
It is important to protect the biodiversity of the region for its own sake.	1	2	3	4	5
Government has a role to play in improving biodiversity outcomes in the region.	1	2	3	4	5
A tender mechanism is a good way for government to help improve biodiversity in the region.	1	2	3	4	5
I understand what is meant by biodiversity.	1	2	3	4	5
It is clear to me how management of my property affects biodiversity.	1	2	3	4	5
I can think of ways to improve or maintain biodiversity on my property that could make good tender submissions.	1	2	3	4	5
A tender system for biodiversity could help me make management changes that I wanted to do anyway.	1	2	3	4	5

Workshop Evaluation

Please indicate the extent to which you agree or disagree with each statement by circling the most appropriate answer

1 = Strongly Disagree 2 = Disagree 3 = Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree

The workshop exercises were clear	1	2	3	4	5
The workshop helped me understand biodiversity tenders	1	2	3	4	5
The workshop was a worthwhile use of my time	1	2	3	4	5

Please note any other issues that may affect your involvement in a biodiversity tender or additional feedback on today's workshop

Thank you for taking the time to attend this workshop and to complete this survey.