

AN OVERVIEW OF KEY SOCIO-ECONOMIC FACTORS, PRINCIPLES AND GUIDELINES IN WILDLIFE “CORRIDOR” PLANNING AND IMPLEMENTATION

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CONTENTS

Executive Summary	v
1. Introduction	1
1.1 Terms of reference	1
1.2 Our approach	1
Defining wildlife corridors.....	2
1.3 Current Australian National Wildlife Corridor Plans	2
1.4 Structure of this report.....	4
2. Why work at the scale of “landscapes” in NRM?	5
2.1 Importance of socio-economic factors in landscape-scale conservation.....	5
2.2 Moving from catchment management to landscape scale management	5
2.3 The nature of the costs and benefits from large-scale corridor initiatives	7
Economic, social and cultural benefits.....	7
Connectivity conservation benefits	8
Potential for wider ecosystem benefits	9
2.4 Benefit and costs of operating at a landscape scale	10
Potential delivery benefits from a connectivity focus	11
Potential risks	12
3. Learning from experience.....	14
3.1 Lessons learnt from other literature	14
Multi-tenure conservation management in Australia.....	14
Common pool resource institutions and adaptive management	15
Ecosystem services.....	17
Transactions costs in environmental policy	19
3.2 Australian wildlife corridor initiatives	20
3.3 International wildlife corridor experiences.....	23
4. Leading practice investment tools in landscape scale NRM programs	25
4.1 What investment tools are available to deliver land use change?	26
Deciding amongst investment options	28
4.2 Emerging investment tools at the landscape scale.....	29
New tools to better deliver corridor initiatives	31
5. Attributes and guidelines in wildlife corridor planning.....	32
5.1 The attributes of wildlife corridor initiatives	32
A1: Underpinned by a clearly articulated vision	32
A2: Promote landscape resilience through connectivity conservation	33
A3: Supported and implemented through an adaptive approach.....	33
A4: Promote the development of resilient human communities.....	33
A5: Corridor initiatives to act as boundary organisation.....	33
A6: Facilitate, nurture and promote partnerships and collaborations.....	34
5.2 Draft framework for developing wildlife corridor initiatives.....	35
5.3 Steps in an adaptive co-management cycle	37
Focus on building ecological and social resilience	39
6. Key messages	40
Reference list.....	42

Appendix 1: Three international connectivity corridor case studies.....	47
Yellowstone to Yukon initiative	47
Greater Cederberg Biodiversity Corridor (GCBC) and Cape Action Plan for the Environment (CAPE)	47
Panthera	48
Appendix 2: Mechanisms for delivering landuse change	50
Appendix 3: Relationships between stakeholders in the wildlife corridor	52
Appendix 4: Additional tools for building collaborative networks.....	53

LIST OF FIGURES AND TABLES

Figure 1: Major corridor initiatives in progress or planned in Australia.	3
Figure 2: Assumed connectivity investment biodiversity benefit relationship	9
Figure 3: Ecosystem services and relationship to human well-being.....	18
Figure 4: IUCN Connectivity Conservation Management Framework	25
Figure 5: Integrating economic design within an adaptive management framework	28
Table 1: Australian large-scale corridor and connectivity initiatives.....	4
Table 2: Available science and risks association with application of science	13
Table 3: Key governance attributes of Australian wildlife corridors.....	21
Table 4: Implementation and funding arrangements of Australian wildlife corridor initiatives.	22
Table 5: Connectivity conservation management tasks.....	23
Table 6: Lessons learnt from international case studies of wildlife corridor initiatives	24
Table 7: Tools and approaches for delivering connectivity actions.....	26
Table 8: Economic design steps via an adaptive management cycle.....	29
Table 9: The attributes of wildlife corridor initiatives.....	32
Table 10: Institutional elements of wildlife corridor initiatives and their function.....	36

EXECUTIVE SUMMARY

Large-scale wildlife corridor and connectivity initiatives are already an active part of natural resource management (NRM) in Australia. The National Wildlife Corridor Plan will not be starting from a clean slate, but rather working with an existing and rapidly developing movement encompassing NGOs, state government agencies, NRM organisations, philanthropies, Indigenous peoples and researchers to name just a few. Each wildlife corridor differs in context, objective, needs, and maturity. Each has different needs. One size will not fit all.

The objectives in this report are to identify:

- The socio-economic characteristics that support the achievement of an effective landscape-scale wildlife corridor
- The societal benefits (and disbenefits) that are likely to accrue through establishment / re-establishment of an effectively linked landscape.

What is a wildlife corridor?

Landscape-scale conservation shifts the conservation focus from a “place” and “project” planning framework towards a planning philosophy that seeks to understand and manage ecological processes across space, scale, jurisdiction and time. Corridor connectivity focus is on functional physical connections between remaining conservation lands. In this report we define these wildlife corridors as *managed and physically interlinked areas of land that are structured around existing natural, intact and functioning areas of vegetation and existing ecological processes, are managed for landscape resilience, and are supported through appropriate socio-economic institutions.*

Key features of existing wildlife corridors include their (very) large spatial scale, the cross-jurisdictional nature of activities, a mixture of land-use patterns occurring within the boundaries of the corridor, and the location of corridors most commonly in low population density and remote locations. They tend to operate under a partnership approach, working with local communities and to incorporate important cultural, social and economic values into their planning processes.

Benefits and costs of wildlife corridor initiatives

As a broad vision, the concept of a wildlife corridor is an important tool in motivating individuals, groups and communities to participate in the on-ground delivery of conservation works. Motivation reduces the transactions costs associated with “selling” any particular on-ground activity related to the wildlife corridor (because individuals are already committed to the vision of what that activity is trying to achieve).

Social and economic benefits from wildlife corridors

The attraction of corridor initiatives is the assumption that a relatively small investment in connectivity management will yield a large conservation pay-off. This assumption is likely to be valid in many settings, but in others a threshold investment may be required in order to functionally connect landscapes ecologically to impact on conservation outcomes. It would be prudent to identify where and to what extent such thresholds are present in proposed initiatives, as well as the required investment to overcome them.

Inclusive processes used in the planning, implementation and management of corridor projects are likely to generate substantial social capital, especially in the environmental

management sector. Social capital is also likely to generate positive economic benefits as networks and strong patterns of communication and information sharing have been shown to facilitate relatively low cost transfer of economic innovation.

The indirect economic benefits of corridor initiatives are likely to be small relative to regional economies. Hence, with the exception of the environmental sector, are they unlikely to generate substantive positive economic impacts in isolation from other initiatives.

Many commentators have also reported on the expected benefits to the community arising out of the generation of environmental services from wildlife corridors. While some new or additional wider ecosystem benefits *may* be protected, created, or enhanced, it is unlikely at current funding levels focused specifically on connectivity management that any net gain in ecosystem service generation would be significant. That is, the wider ecosystem service impacts are likely to be small and marginal.

Project scale costs associated with wildlife corridors

The benefits of wildlife corridors are offset, to a certain degree, by the generation of a range of opportunity, managerial and transactions costs. These costs include:

- Substantive impacts on some, relatively small parts of landscapes. The desired connectivity management activities will have direct impacts on these landholders that may reduce their income
- Ongoing management costs dependent on the range of activities undertaken in the corridor – for example, re-vegetation/restoration activities are likely to require higher management resources than reducing agricultural intensity
- Impacts on option values (that is, loss of opportunity for future development) in some settings, particularly for peri-urban development (albeit offset by retained ecosystem service values in these settings). Agricultural option values (the most common) will be low in most settings due to native vegetation clearance restrictions and few opportunities remaining for profitable development
- Significant transactions costs associated with establishing wildlife corridors, although policy design can greatly assist with managing these costs.

Overall, corridor initiatives are unlikely to have substantive adverse impacts on local economies because their economic footprint is likely to be small relative to regional economies.

Potential risks of the wildlife corridor approach

Corridor initiatives face a range of risks, primarily resulting from their organisational structure and relationships (institutional proliferation, fragmentation and conflict) and from the underpinning knowledge base (limitations to landscape ecology science and other barriers to implementation).

Social and economic lessons from experience to date

Substantial analysis is emerging from corridor initiatives in Australia and internationally, as well as from other multi-tenure approaches (such as biosphere reserves, common pool resource management and ecosystem services approaches). The social and economic lessons that can be learnt from these approaches are synthesised into a conceptual framework for developing initiatives, supported key steps in implementation, and finally a set of attributes that all corridor and connectivity conservation initiatives should exhibit.

A draft conceptual framework for developing wildlife corridor initiatives

We recommend that an *adaptive co-management approach* is adopted as an overarching framework for considering and implementing wildlife corridors, and for shaping their operational dynamics. Implementation of an adaptive co-management approach should cover five elements:

- Exploratory analysis of the natural resources and human community
- Facilitation of community ownership and a shared community vision
- Identification and prioritisation of strategies and projects
- Forging of implementation partnerships
- Designing and negotiating internal rules of operation
- Updating and refinement.

The corridor institution will best function as a boundary or “umbrella” organization. The most important role of a boundary organisation in a corridor initiative is to act as the “glue” that links stakeholders; providing a coordination, network link and facilitator across the organisations and interested stakeholders within and beyond the boundaries of the corridor initiative. Nevertheless the corridor initiative is an institutional construct that will require a mandate and clarity in operational remit and process. Five elements will need to be negotiated and agreed to support the initiative: an agreed membership or stakeholder base (effectively the boundary of the organisation); a set of agreed rules and processes for governing the initiative; a decision making body (inclusive or exclusive, formal or informal such as a steering committee, working group or board); a secretariat or host; and a relationships with a range of partners responsible for at least some aspects of on-ground implementation.

Practical implementation will require a range of overlapping approaches

A clear and compelling *vision*, owned by the participating community, is critical to selling the corridor concept (Worboys *et al.* 2011). An agreed vision provides the focus for the initiative, encouraging partners to focus on their commonalities in delivering connectivity conservation outcomes and reducing the costs of coordination and negotiation.

Moving from vision to implementation requires the translation of aspirational concepts into *practical plans and priorities* to be actioned. Existing initiatives already use various forms of adaptive co-management approaches. The most common approach in Australia is the Conservation Action Planning approach – but there are other suitable approaches available. Complementary approaches with differing emphases which may prove useful in building collaborative networks include collaborative focal species approaches, scenario analyses for community visioning, and the collaborative habitat investment atlas.

A key stage in implementation is the selection and implementation of *investment tools* to deliver the desired on-ground activities at an integrated landscape scale. As boundary institutions corridor initiatives face additional complexity in assembling the available tools into a strategic package and delivering them in an integrated way. They do however have access through their partnerships to a range of networks, skills, knowledge and other advantages that are unlikely to be available to any single organisation, even large-scale NRM organisations and state agencies.

Increased resourcing means corridor initiatives will need to move to a less opportunistic and more strategic approach in identifying and implementing investment tools. We set out a four step process for identifying, selecting, implementing and measuring and monitoring investment tools. Step A focuses on gathering the social, biophysical and economic

information necessary to support a decision in Step B about a specific mode of influencing land management. Step C concentrates on refining the selected tool or mechanism to deliver the desired outcome most effectively and efficiently. Finally, Step D involves assessing performance, capturing lessons and feeding into future improvement of tools and approaches to influencing land management in corridor initiatives. This process can relatively easily be embedded within other existing processes such as Conservation Action Planning, as well as accommodating the new tools that will be required to deliver at landscape scale.

Economic design steps via an adaptive management cycle

Step A	Step B	Step C	Step D
Resource condition and threats	Mode of intervention available	Targeting (values, stakeholders, process)	Performance measurement
Benefit/cost values (and to whom)	Market and governance failures	Design/negotiate delivery partnership	Compliance
Opportunities to manage resource	Mechanism options (how to deliver)	Effective stakeholder engagement	Evaluation
Human and institutional drivers	Ensuring net benefits result	Effective delivery process and practice	Transferring learnings

Draft attributes underpinning wildlife corridor institutions

Initiatives promoted and supported by the National Wildlife Corridor Plan should be:

1. Underpinned by a ***clearly articulated vision*** that sets out what is to be achieved
2. Primarily to promote ***landscape resilience through connectivity conservation*** however they can, and should, fulfil other social and economic needs of the community
3. Supported and implemented through an ***adaptive policy cycle*** approach to build in learning about ecological and social systems and manage uncertainty
4. Promoting the development of ***resilient human communities*** capable of implementing adaptive management and self-sustaining momentum
5. Acting as ***boundary organisations*** whose purpose is to coordinate stakeholders across various scales and to facilitate the necessary flow of resources, information and skills required to conduct on ground implementation activities
6. Evolving toward governance structures that ***facilitate, nurture and promote partnerships and collaborations*** across and between scales and between stakeholders with a wide variety of skill sets.

Finally, we suggest that corridor initiatives embed a resilience focus across their vision, organisational structure, and implementation approaches. The importance of different corridor initiative elements to resilience will vary but should encompass biophysical (conservation) design, institutional or rules governing the initiative, organisational structures and processes, and engagement with the wider community and economy.

1. INTRODUCTION

1.1 Terms of reference

The Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) is preparing a set of information to support the development of the *National Wildlife Corridors Plan (NWCP)*. The NWCP is intended to support a more strategic, landscape-scale approach to managing biodiversity. The landscape-scale focus requires the consideration of a mix of land-uses, stakeholders, and management practices to deliver the desired critical linkages to allow species movements and protect biodiversity in a changing climate.

DSEWPaC has requested that this consultancy provide information on the potential scale and scope of the social and economic impact of wildlife corridors, specifically:

- The socio-economic characteristics that support the achievement of an effective landscape-scale wildlife corridor
- The societal benefits (and disbenefits) that are likely to accrue through establishment / re-establishment of an effectively linked landscape.

The focus of the work presented is on existing socio-economic research relevant to land-use planning, natural resource management and biodiversity conservation. It includes consideration of the results of a parallel report (Whitten *et al.* 2011) that describes the operational experience of existing and planned corridor initiatives and informs the research presented in this report.

1.2 Our approach

Australia's decade or more experience with devolved conservation has shown the potential of the regional natural resource management (NRM) approach to deliver effective broader NRM outcomes. However these organisations are not well equipped to deliver the more strategic, large-scale multi-region connectivity approach to managing biodiversity required under the NWCP. Instead, research suggests that a multi-level governance and collaborate adaptive management approach presents a more effective model. Indeed the NWCP envisages the Australian Government working with regional and community groups, environmental organisations, other governments and private sector interests to produce a plan for creating corridors that will form critical linkages in the landscape to allow species movements and protect biodiversity in a changing climate. The wider focus reflects a broader movement towards conservation action that promotes resilience within the landscape. Conservation of ecological assets such as soil health or patches of bushland will remain important drivers in natural resource management. However, the protection of ecological assets is increasingly viewed a mechanism to achieve the broader goal of promoting landscape resilience to changes in the broader socio-economic and biophysical environment, particularly the challenges of adapting to a changing climate.

In this context, wildlife corridors are becoming an increasingly popular policy and institutional response to the challenges of promoting landscape sustainability. Described invariably, and simultaneously, as a “vision”, “planning framework”, “discourse” and “coordinating organization”, a wildlife corridor seeks to facilitate and coordinate a range of conservation activities across multiple scales for the purpose of biodiversity conservation. By adopting a broad definition of biodiversity conservation, wildlife corridors seek to promote landscape adaptability, or resilience, and through this, help build resilience in communities who depend on the land.

The value of wildlife corridors in building landscape and community resilience was recognised by the commitment by the Australian Government of \$10 million over 3 years to develop a national plan for wildlife corridors and facilitate pilot project “wildlife corridor” initiatives. This report supports this initiative through a discussion of the wildlife corridors approach to building resilience.

Defining wildlife corridors

Wildlife corridor initiatives implemented at a landscape scale can take on many forms. Worboys (2010) for example describes landscape, habitat, ecological, and evolutionary scale corridors. A recent related concept is that of connectivity for climate change (or climate connectivity), which is intended to make it easier for plants and animals to shift their ranges in response to climate change—a specific form of Worboys’ evolutionary connectivity. For the purposes of this report we draw on connectivity corridor literature, Whitten *et al.* (2011), and the government’s intention as expressed in their election commitment to define national wildlife corridors as *managed and physically interlinked areas of land that are structured around existing natural, intact and functioning areas of vegetation and existing ecological processes, are managed for landscape resilience, and are supported through appropriate socio-economic institutions*. Within this definition, national wildlife corridors merge into evolutionary scale connectivity initiatives. This definition implies four corridor attributes that underpin discussions in this report:

1. *Scale*: the wildlife corridor has to be of sufficient size to deliver evolutionary connectivity across multiple ecological communities
2. *Scope—jurisdiction and tenure*: typically achieving evolutionary connectivity will involve multiple jurisdictions at the local, NRM region, state and occasionally national or continental level
3. *Scope—partnerships*: effective connectivity management will usually require collaborations across multiple forms of tenure including public, private, Indigenous and other tenure arrangements. Effective collaborations are likely to involve organisations that can best engage and leverage values across these tenures including governments, regional NRM bodies, NGOs, businesses and others (such as statutory authorities)
4. *Institutional support (social and economic)*: our analysis relates to corridor initiatives (albeit immature) with a formalised governance and implementation structure and strategy. That is, we discuss necessary components and support for initiatives rather than steps in creating them from scratch.

1.3 Current Australian National Wildlife Corridor Plans

The report “A compendium of existing and planned Australian wildlife corridor projects and initiatives, and case study analysis of operational experience” (Whitten *et al.* 2011) has been prepared by the consultants as a companion to this study. Whitten *et al.* provide a comprehensive catalogue of National Wildlife Corridor Plans in Australia and analyse the key features of the structure, implementation and operation of existing wildlife corridor practice. **Figure 1** provides an over view of the geographical spread of the Australian wildlife corridors currently under construction, in the planning phase or under conceptual development. Clearly the concept of wildlife corridors is now widespread across Australia.

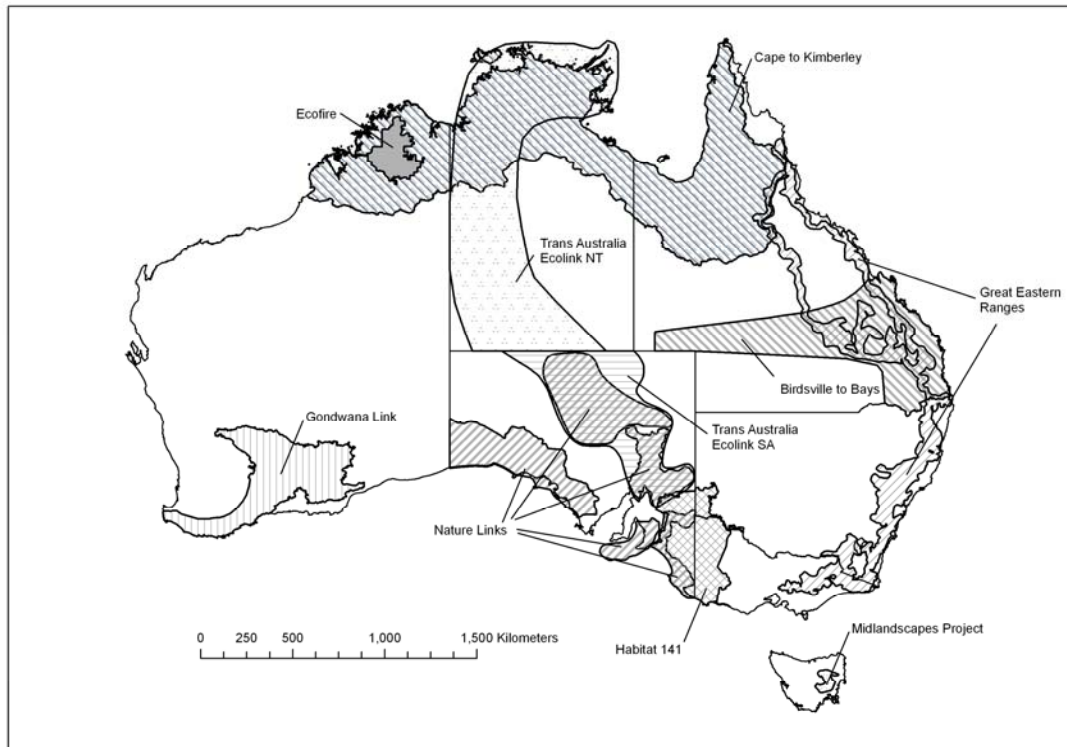


Figure 1: Major corridor initiatives in progress or planned in Australia.

Source: Created from individual project GIS and line mapping where not available.

The initiatives examined in Whitten *et al.* (2011) are listed in Table 1 along with their geographical location. From this table, and the material developed in Whitten *et al.*, it is clear that wildlife corridor practice in Australia tends to be:

- Covering a very large spatial scale—at least regional, and, in some cases, continental in scale and scope. There are three initiatives currently in planning/implementation stages that cross the continent – the Great Eastern Ranges, the Trans Australia Ecolink and the Cape to Kimberley
- Cross-jurisdictional—encompassing several NRM regions, with some across state borders
- Working across a range of ecosystems and climate regimes—essentially following transects (usually north-south) or altitudinal gradients across the landscape
- Working with mixed land-use patterns—with patches of land already in the public or private protected area estate, some land used for food/fibre production and some under another use. All work across different land tenures. All work with biodiversity assets of varying quality and with different levels of extant biodiversity conservation management and protection
- Generally covering areas that are relatively remote and have low population density—that is, with some exceptions (for example, sections of the GER and the Birdsville to Hervey Bay corridor, one SA NatureLink etc.), they largely fall west of the densely populated eastern seaboard zone
- Incorporating culture, social values and economic opportunities within the planning processes

- Making a commitment to “work with local communities” to conserve large landscapes.

Table 1: Australian large-scale corridor and connectivity initiatives

Program	Scale	Location
1. Great Eastern Ranges	Continental	Victoria, NSW, ACT, Queensland
2. Gondwana Link	Regional	Western Australia
3. Habitat 141° (Outback to Ocean)	Regional	Victoria, South Australia
4. Trans Australia Ecolink Corridor	Continental	South Australia, Northern Territory
5. Nature Links	Regional	South Australia
6. Territory Eco-Link (part of Trans Australia Ecolink)	Regional	Northern Territory
7. Birdsville to Hervey Bay	Regional	Queensland
8. Tasmanian Midlandscapes	Regional	Tasmania
9. Cape to Kimberley	Continental	Queensland, Northern Territory and Western Australia
10. Ecofire	Regional (>5 M ha)	Western Australia

Source: Whitten *et al.* (2011)

1.4 Structure of this report

Our research into the social and economic aspects of corridors is presented as follows:

Section 2: Presents a case for working at the scale of national wildlife corridors including discussion of the scope and nature of economic and social benefits from large-scale initiatives

Section 3: Describes a set of lessons that are derived from experiences of large-scale, multi-tenure, multi-partner natural resource management. It includes discussion of common pool resource management, ecosystem services and transaction costs in environmental management. We incorporate the lessons from the Australian and international wildlife corridor experience

Section 4: Sets out the leading practices in investment in conservation management including a synopsis of which tools are available and best suited, and a preliminary assessment of emerging opportunities and missing tools

Section 5: Identifies preliminary principles and guidelines for understanding National Wildlife Corridor Plans. These principles describe the social and governance attributes that contribute to the success (or failure) of initiatives

Conclusions: The report is completed with a summary of the conclusions and key messages from the research.

2. WHY WORK AT THE SCALE OF “LANDSCAPES” IN NRM?

2.1 Importance of socio-economic factors in landscape-scale conservation

The view that “Natural Resource Management (NRM) is about managing people's activities as much as it is about managing resources” (Stratford and Davidson, 2002, p429) is now common place within Australia's NRM community and with good reason—matters of culture, values, economic livelihoods and communities act to shape the capacity and willingness of people to contribute to, and support, landscape sustainability.

The development of wildlife or conservation corridors is primarily driven by the imperative to provide more effective interventions for protecting and strengthening natural ecosystems and ecosystem processes (Worboys *et al.* 2010). Their construction and on-going maintenance is, however, embedded within a landscape that is shaped by a broader, multi-scaled socio-economic system of human activity. This socio-economic system, and the institutions through which it operates, influence the construction and on-going maintenance of wildlife corridors in two important ways. First, the economic and social institutions that exist at various scales, act to influence the incentives that communities face when making decisions about resource management. These formal and informal institutions also help to frame the emotional and cultural attachments that connect people to the land, and a “sense of place”. In turn the institutional structure influences community perceptions and resource use decisions, with consequences for biodiversity conservation and the benefits of alternative land uses (Sandström 2009; Cheng *et al.* 2003). Second, policies, programs and other interventions can determine the flow of financial, labour, knowledge, and policy resources used to establish, develop and maintain the wildlife corridor.

In Australia, wildlife corridors exist across vast geographical areas that are generally sparsely populated. For practical reasons, large-scale biodiversity initiatives need the labour, information, skills and financial resources that the local communities can deliver, often on a voluntary basis. Stakeholder engagement and cooperation at the local level is effective in building informal institutions to support natural resource management (Opdam *et al.* 2006; Prager 2010). Targeting resource conditions, without a commensurate consideration of the socio-economic conditions under which communities value those resources, can induce a significant political backlash to any NRM initiative. Understanding these socio-economic conditions, and explicitly incorporating them into project design, can help develop cooperation and trust—key elements in engaging communities, particularly land managers, in biodiversity initiatives (Fitzsimons and Westcott, 2007). Finally, experience elsewhere has demonstrated that large-scale wildlife corridors are successful only when communities are able to engage with partnership organizations that operate beyond the scale that individuals and local organisations can (Lombard *et al.* 2010). In turn, these organizations participate because they hold social, spiritual or cultural values in the landscape. Understanding these values, and using them appropriately, can be a powerful driver to facilitating these necessary partnerships.

2.2 Moving from catchment management to landscape scale management

Over the past decade the primary frameworks for natural resource management in Australia have been “regional scale” through regional NRM organisations. NRM boundaries tend to act as barriers in planning and implementing conservation of ecosystems or natural assets, with goals, targets and activities set independently across neighbouring NRM regions. Landscape-

scale conservation differs from this catchment oriented approach by a shift in emphasis away from a “place” and “project” planning framework to a planning philosophy that seeks to understand, and manage ecological processes across space, scale, jurisdiction and time. This approach seeks to direct conservation work towards managing the risks that ecosystems, and their dependent communities, may face. The pragmatic expression of this *process* focus is framed through the idea of developing meaningful and functional physical “connections” between remaining “wild lands” or conservation reserves for the purposes of promoting “multiple focal species or propagation of ecosystem processes” (Beier *et al.* 2008). Landscape-scale approaches to conservation also provide a framework that enables diverse land-uses—consumption, production, protection—to come together within a conservation area (Argent 2002; Holmes 2006; Holmes 2010; Perfecto *et al.* 2010).

The imperative for connecting the landscape is derived primarily from conservation biology and landscape ecology where the maintenance of ecological processes (and not just ecological assets *per se*) is considered to be key to building landscape and biodiversity resilience in the face of continued human induced pressures, particularly the pressure of climate change adaptation (see Whitten *et al.* 2011 for further discussion). It is also a key component of international agreements supported by the Australian Government through the Convention on Biological Diversity (CBD) Aichi targets and via membership with the International Union for the Conservation of Nature (IUCN).¹ Worboys *et al.* (2010) emphasise three dimensions of this resilience oriented imperative:

- Provide connectivity between habitats for selected species, thus increasing their range
- Provide connectedness between vegetated areas in order to preserve the ongoing expression of ecological processes that may occur within the landscape across or between scales. For example, connected habitat is better able to express and maintain established trophic relationships or fire patterns
- Provide connections between habitats to permit the continuance of genetic evolution and adaptation that require the movement of species over large land areas.

Achieving these conservation goals generally requires the physical scale of conservation zones to approximately match ecological processes scale, generally beyond regional NRM boundaries.

Managing social, institutional and economic drivers influencing the landscape also requires attention at a larger scale than the NRM region or community. For example, land tenure institutions, designed to promote development and food security, may inadvertently work against the conservation objectives of the wildlife corridor. Several authors (for example, Cash *et al.* 2006) have identified this “mismatch” between the (geographical) scale of the ecological phenomenon and the scale of operation of the human institutions. A further issue for biodiversity conservation identified by Steinberg (2009) surrounds a disjuncture in temporal scale between the long-term requirements of biodiversity conservation and the short time horizons governing public and private decisions. Matching, or at least scaling towards equivalent boundaries assists in managing these drivers.

Hence landscape-scale conservation work necessitates the coordination and aggregation of community based conservation efforts across multiple regions (Wyborn, *in press*). Scale aggregation has two further advantages: first it facilitates local engagement with large-scale stakeholders who may otherwise not have the capacity to work with small community based groups; and second it may provide opportunities for communities to engage in markets for

¹ The CBD Aichi targets can be found at: <http://www.cbd.int/sp/targets/>. The IUCN thematic group on connectivity conservation supports a range of research and initiatives and can be found at: http://www.iucn.org/about/union/commissions/cem/cem_work/connectivity_conservation/.

alternative income producing commodities or markets for environmental services which require a minimum scale to operate effectively.

2.3 The nature of the costs and benefits from large-scale corridor initiatives

The initial tranche of Australian Government investment will be in developing a plan for wildlife corridor initiatives (\$10 million AUD over 3 years). However, further investments may be made in the future, which may leverage additional private investment, and it is envisaged that there will be contributions from a range of other government, philanthropic, NGO and business sources. Regardless of the total sum of financial investment, this report assumes that the level of funding available to wildlife corridor initiatives overall will be relatively small compared to the aggregate potential for investment in corridor related activities (including land use change) and when compared to regional economies within which corridor initiatives are located. The available financial resources will influence the possible range of ecological and socio-economic outcomes one may expect from a wildlife corridor initiative. As a consequence, we set out some key assumptions about the relative economic and social costs and benefits associated with these investments before discussing the ensuing connectivity and other environmental benefits.

Economic, social and cultural benefits

With respect to the economic costs of wildlife corridor investments, this report assumes that:

- Management of structural connectivity to deliver functional connectivity objectives will involve a range of land uses, many of which will continue to support a mix of agricultural and conservation outcomes (Perfecto *et al.* 2010). Hence, at the scale of a regional economy (for example, within a catchment area) there is likely to be relatively little conversion within the wildlife corridor from agricultural uses to re-vegetation or other primarily conservation uses. Consequently, the opportunity costs are relatively small (as measured by the value of lost agricultural production)
- There may be significant land use change for some (relatively few) individual landholders reflecting change at the “paddock” and “property” scale in targeted high priority areas
- Generating substantial biodiversity outcomes is likely to require significant ongoing management costs. Actual costs will depend on the range of activities used in the construction of the corridor. For example, re-vegetation/restoration activities are likely to require higher management resources than reducing agricultural intensity
- There may be significant loss of option values (that is, loss of opportunity for future development) associated with potential development in some settings, particularly in peri-urban or more intensive agricultural and forestry settings. But because ecological management advice suggests that initiatives will tend to target protection and maintenance of existing assets over creation of new assets, there is likely to be a relatively small loss of agricultural option values in most settings due to native vegetation clearance restrictions and the likelihood that improved management of existing structural connectivity will be most cost-effective with relatively modest investments
- There are likely to be significant transaction costs associated with establishing wildlife corridors, although policy design can greatly assist with managing these costs.

While the aggregate costs may be substantial to funders of the corridor, the relative level of funding flowing into communities for wildlife corridor projects compared to other sources is likely to limit the impact on local economic activity. However, the targeted nature of

investment is likely to provide an important contribution to the local and regional environmental sector (that is, deliver a significant economic benefit to that sector).

More significant benefits are likely to come through the engagement processes used in the planning, implementation and management of corridor projects which generate substantial social capital. Social capital represents the value of networks and relationships among individuals and is a key element in building and strengthening community resilience and community adaptation capacity (Pahl-Wostl 2006; Reed *et al.* 2010; Rist *et al.* 2007). It is particularly important to conservation initiatives, where the low levels of public concern around the risk to human society of biodiversity loss is a key barrier (Novacek 2008). Enhanced social capital generates flow-on economic benefits as networks and strong patterns of communication and information sharing have been shown to facilitate relatively low cost transfer of economic innovation.

Wildlife corridor initiatives also have the potential to take account of the distinctive socio-cultural characteristics that influence Indigenous engagement in, and historical marginalisation from, natural resource management (Hill *et al.* 2009). Evidence is emerging that many of the challenges that result in Indigenous marginalisation can be overcome where Indigenous communities conduct their own planning and management priorities for NRM, on their own terms (Lane *et al.* 2005; Lane *et al.* 2009). Indigenous protected areas (IPAs) are a form of Indigenous-driven engagement in conservation that demonstrates the capacity to deliver multiple ecological, social and cultural benefits (Gilligan 2006). Innovative IPA management plans demonstrate Indigenous cultural preferences on country, including the importance of landscape linkages (Walsh *et al.* 2011). For example, site complexes, dreaming tracks and song lines, mapped as key values for management in the Northern Tanami IPA, resulted in a spatial configuration of values reminiscent of ecological networks targeted through corridor initiatives (Hill *et al.* 2011a). However, these values on country are as much an expression of social, cultural and spiritual identity as a characteristic of the place, and Indigenous conceptions of appropriate care or management can differ from a scientifically-derived NRM agenda (Strang 2008). Indigenous-driven engagement in corridor initiatives, tailored to the local context of Indigenous rights and interests, are likely to be critical to ensuring the delivery of mutual benefits to biodiversity and Indigenous peoples (Hill 2011a; Carter 2010).

Connectivity conservation benefits

Conservation benefits from national wildlife corridors result from the extent to which they are able to deliver benefits at any scale beyond the biodiversity benefits accessible using existing approaches. We explicitly assume that the existing configuration of the landscape means that a set of low-cost, high benefit investment options exist, with the marginal benefits to conservation gradually declining as investment increases (described in more detail in Section 2.4). Well designed corridors are likely to focus on key elements of structural connectivity in landscapes with the objective of delivering functional connectivity between existing relatively high quality “patches” or areas of ecological communities. The focus is on supporting these patches and the populations they contain at the same time as reconstructing or supporting functional links between them. The declining marginal value of investment concept is illustrated in Figure 2—with and without a threshold to deliver connectivity benefits (there may be multiple thresholds at difference scales).

The result of this assumption is that we assume a small investment targeted towards key connectivity impediments is able to deliver a proportionately larger conservation outcome than a larger investment which does not target connectivity as the first priority. The attraction of corridor initiatives is the assumption that a relatively small investment in connectivity management will yield a large conservation pay-off. This assumption is likely to be valid in many settings, but in others a threshold investment may be required in order to sufficiently

functionally connect landscapes to impact on conservation outcomes. It would be prudent to identify where and to what extent such thresholds are present in proposed initiatives.

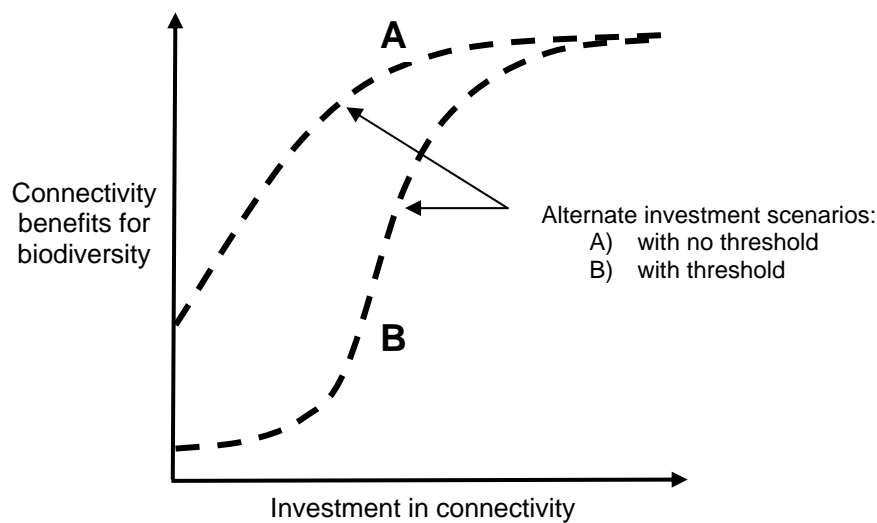


Figure 2: Assumed connectivity investment biodiversity benefit relationship

Potential for wider ecosystem benefits

Many commentators have reported on the expected benefits (monetary and non-monetary) to the community arising out of the generation of environmental services from wildlife corridors (see for example: USDA, 2004; Worboys *et al.*, 2010 case study on the Great Eastern Ranges Corridor). The scale of wildlife conservation corridors means that these initiatives are very likely to generate substantial ecosystem services to landholders and communities, within and beyond their boundaries.

The primary aim of NWCP is biodiversity conservation via facilitation of evolutionary connectivity and consequent processes. This means that activities will be structured primarily towards achieving functional ecological connectivity rather than the delivery of other ecosystem services. Hence the primary contribution will be to biodiversity protection, but it is possible that the range of activities envisioned by corridor initiatives may generate wider benefits. Whitten *et al.* (2011) set out a range of specific activities pertaining to protected areas, other land and to the agricultural matrix that corridor initiatives will encompass. These can be grouped into three areas:

- Maintaining or enhancing existing assets that already deliver these services to the community—such as buffering protected areas
- Protecting and enhancing existing structural connectivity such as paddock trees, remnants and other habitat types
- Creating new structural connectivity via revegetation and other actions.

These proposed activities are likely to deliver a more sustainable mix of land-uses within corridor boundaries over time. They are likely to contribute to the protection of ecosystem services, probably above and beyond other less targeted investments. These ecosystem services are likely to fall into three general classes (loosely following the Millennium Ecosystem Assessment 2005):

- Benefits within corridor boundaries and which support primary industries (food and fibre production, water related services, pollination and local climate regulation). There may also be costs if land use change leads to increased fire, weed or pest

animal threats (see Mooney and Hobbs 2000 on weeds for example). These benefits directly generate economic return to farmers and businesses (Zhang *et al.* 2007)

- Benefits which generate other use values within and beyond corridor boundaries (water related services, recreation and aesthetic, and education in particular). These benefits support healthy and vibrant communities and human well-being
- A range of non-use benefits (sense of place, cultural heritage, and spiritual values) which contribute to a wider cultural richness and human well-being.

It is difficult, however, to determine the overall impact that corridor initiatives may have on the maintenance and production of ecosystem services. However, biodiversity is a source of many ecosystem services (MEA 2005), and we argue that investment will make a significant contribution to long term biodiversity protection. Furthermore, the MEA notes, the real impact of the loss of biodiversity is the extent to which the ecosystem loses functional redundancy, rather than biodiversity assets per se. Protecting biodiversity therefore represents a strengthening of resilience in the landscape through a strengthening of the scope and range of biodiversity redundancies (or “option value”) in the landscape. The value of protecting this “functional redundancy” may be high as climate change impacts on biodiversity over time.

Our assessment is that the potential gain to ecosystem services (compared against continuing current activities within corridor boundaries) is dependent on the extent to which ecosystem service benefits respond to these corridor initiatives *and* the extent to which these services are experienced by humans. The difficulty is in assessing the likely response function.²

Evidence suggests that there will also be response thresholds in individual ecosystem services that are similar to curve B in Figure 2 (see for example Samways *et al.* 2010 or Kremen 2005). For ecosystem services other than biodiversity conservation to strongly benefit from corridor investment activities they would need to be generated by the same activities, be generated by the same locations in the landscape, and require a similar scale of actions, to the proposed connectivity actions. There is no clear evidence that this is the case for a wider set of ecosystem services. Therefore, while some wider ecosystem benefits *may* be protected, created, or enhanced; it is unlikely at anticipated investment levels that the net gain in ecosystem service generation would be sufficient to materially benefit income producing activities, such as agriculture, or to significantly benefit urban communities. That is, the wider ecosystem service impacts are likely to be small and marginal. Furthermore, the realisation of these ecosystem benefits will be highly dependent on site characteristics of the specific wildlife corridor activity and planning decisions made at the local level.

2.4 Benefit and costs of operating at a landscape scale

Existing NRM institutions operating at the catchment scale already manage a range of risks and benefits associated with NRM. For example, investments may be put at risk through changes in rainfall patterns, or through commodity markets that influence the price of land slated for conservation works. Wildlife corridors, as a new NRM initiative that operates across CMA jurisdictions, should be expected to deliver benefits over and above the capacity or remit of existing institutions. Conversely, wildlife corridor initiatives may introduce new types of risks into the NRM system, which will need to be managed, and ideally, minimised, through careful institutional design and policy selection.

² In practice investors should make explicit assumptions, measure the responses that do occur, and modify management accordingly.

Potential delivery benefits from a connectivity focus

The potential benefits centre around the conceptualisation of a wildlife corridor as simultaneously being a “broad vision” for future connectivity conservation objectives, a management framework, and a network necessary for building strategic relationships between potential project partners (Chester, 2006).

As a “broad vision”, prior experience in wildlife corridor initiatives have identified the importance of creating, and communicating effectively an ambitious, even romantic, goal for biodiversity conservation. The sense of tangibly contributing to regional and continental scale connectivity motivates individuals, groups and communities to participate. Similarly, large-scale concepts such as conservation of a “key-stone species” are promoted to capture the imagination and appeal to would-be project participants (especially volunteers or donors) at an emotional level in order to generate the political and financial support as well the as in-kind resources required to deliver landscape scale conservation activities (see for example Yellowstone to Yukon, 2011). This motivation to participate acts to reduce the transaction costs associated with “selling” any particular on-ground activity related to the wildlife corridor (because individuals are already committed to the vision of what that activity is trying to achieve). It can also help in managing friction that may arise should communities or individuals be required to compromise their welfare outcomes in order to implement corridor activities.

The second major benefit of working at scale is as a management framework within which to coordinate biodiversity conservation activities across spatial, temporal, jurisdictional, institutional, community, knowledge and ownership scales. Corridors thus assist in overcoming institutional fragmentation, knowledge uncertainty, and contested interests across a landscape (Pert *et al.* 2010): often through the use of participatory tools that ensure integration of science, local and Indigenous knowledge, and recognise the diversity of human values associated with the environment (Berkes 2006; Hill *et al.* 2010).

Corridors achieve this primarily via an emergent “boundary” organisation that is embedded within a network of diverse stakeholders each of whom have different levels of involvement, interest and participation in, or contribution to, the wildlife corridor (Lombard *et al.* 2010; Hill *et al.* 2010). By articulating a broad vision linked to broad scale management strategies, the wildlife corridor initiative acts to link the activities of individual stakeholders to the strategic biodiversity outcome and to facilitate partnerships between stakeholders in order to garner the required resources necessary to implement on-ground projects. As boundary organisations, wildlife corridor initiatives also have the capacity to aggregate the needs of on-ground conservation groups and communities to levels that are able to engage with large, cross-scale institutional players who may otherwise not have the capacity to form relationships with small scale community organizations. For example, The Wilderness Society’s Wild Country Program has engaged with wildlife corridor initiatives such as Gondwana Link in order to deliver on-ground scientific research (Gondwana Link, 2007).

Corridor initiatives tend toward a partnership model (Whitten *et al.* 2011) which is inclusive of community groups, NGOs and other interested stakeholders and is a key strength that sets them apart from regional NRM groups, which although often operating in partnerships and exhibiting high levels of consultation, do not tend towards inclusion of NGOs and other interested stakeholders in high level internal decision making. Furthermore, the focus on biodiversity conservation provides another dimension to enrich and complement, but not replace, the catchment based conservation management frameworks undertaken through regional NRM bodies. Participants in community-based initiatives report that compared to the government sector, their organizations generate a more conducive atmosphere to creative innovative and transformative actions to enhance their adaptive capacity (Gooch *et al.* 2009).

Potential risks

Drawing on the case study work compiled for Whitten *et al.* (2011), as well as the available literature, we identify a number of risks of operating wildlife corridors at scale. Risks can be divided between organisational / institutional risks, and biophysical and science based risks, and scale / investment mismatches.

Organisational / institutional risks arise from:

1. *Proliferation of potentially overlapping organisations* via the introduction of yet another collaborative management regime. The additional layer adds to complexity and may place additional work it places on individuals, groups and communities as they participate in the process of cooperation (for example, attend meetings, read papers, and engage in negotiation). In rural regions with smaller populations and capacity to fulfil community representative roles (not an unreasonable assumption), there is a risk that the wildlife corridor projects could create an unsustainable work load for volunteers and volunteer burnout. Indicators include high volunteer turnover with commensurate costs in developing and maintaining social capital and organisational knowledge.
2. *Fragmented implementation and gaps between planning processes*. Drawing on the experience of the Slopes to Summit initiative, Whitten *et al.* (2011) highlight that even with the best biophysical and spatial planning, the implementation of wildlife corridor concepts into on-ground works is often diluted from the original plan due to a misalignment of opportunities from objectives. This arises from number of reasons:
 - The expense and time in targeting the very specific areas and specific landholders necessary for connectivity outcomes
 - The continuing reliance on existing funding mechanisms – which provide funding for wildlife corridor activities in an ad hoc, opportunistic way, leaving gaps rather than focusing activities in a strategic coordinated pattern
 - Wildlife corridor partners having diverse objectives that may not cover, or be able to deliver, all aspects of a wildlife corridor plan. For example, no partner organisation may wish to target delivery of buffering land management
 - Lack of appropriate policy or mechanisms to address small scale, low quality or dispersed biodiversity assets.
3. *The risk of conflict* - corridors could undermine conservation imperatives by making explicit the differences in values and perspectives on ecological assets in a landscape. For example, Prager (2010) notes that conflicts can arise between local groups (such as Landcare) and regional organizations such as NRM bodies, due to differences in institutional scales and the different perspectives they bring to decision making.

Biophysical and science based risks derive from the either the underpinning conservation science or its application in wildlife corridors. These risks include:

4. *The science of landscape ecology* is relatively new and, given the difficulty in studying landscape-scale change, scientific information about changes arising from wildlife corridors is limited. Despite their popularity in conservation circles, corridors and connectivity have been the subject of ongoing debate in the academic literature (Hilty *et al.* 2006). There is empirical evidence to suggest that corridors provide movement for some species (Saunders *et al.* 1991; Haas, 1995; Haddad, 1999; Tewksbury *et al.*, 2002), while other studies suggest they do not (Rosenburg *et al.*, 1998; Haddad and Baum, 1999; Collinge, 2000). In part, this uncertainty can be attributed to the varied, complex, and context specific nature of corridors and

connectivity. The degree of risk associated with using incorrect science, or incorrect application of the science, differs for the different components of connectivity conservation—locating a corridor for maximum benefit, maintaining protected areas, buffering protected areas, managing the matrix, and connecting protected areas. Table 2 provides an indication of the level of scientific research available for each element and the risks associated with incomplete or incorrectly applied research leading to poor outcomes.

5. *Limited skills or resources to access and translate scientific literature into practical and pragmatic management approaches.*

And finally:

6. *Scale / investment mismatches* can arise where there is a threshold relationship between investment and benefit. Small or incorrectly targeted investments may deliver little or no biophysical response. Assessments of the potential for threshold impacts are complicated by the substantial delay between management change and impact from a scientific perspective compounded by (relatively) immediate feedback from incorrect management of the social dimensions of a wildlife corridor.
7. *Barriers to implementation:* posed by institutional constraints, financial limitations or other factors.

These risks primarily arise from the variation of the amount of available scientific research on best way to design each component as set out in Table 2.

Table 2: Available science and risks association with application of science

Biophysical design principle	Strength of evidence	Relative risk
Locate along gradient for climate change adaptation	Small number of individual studies, supported by general ecological principles	moderate
At least 10% remnant native vegetation, preferably 30%	Small number of individual studies	moderate
Enough protected area to support >4000 individuals of most species (>20,000ha?)	Meta-analysis across many studies (worldwide), plus small number of individual studies of area requirements of native species	low
Actively manage protected areas	Many studies and reports	low
Buffer with lower intensity land use, manage threats & retain/restore some elements of native communities—width based on width of edge effects	No specific studies in buffering in Australia, though some edge effects well established as a problem	high
Manage landuse matrix like buffer areas but can allow higher intensity land use and fewer native elements	Small number of individual studies	moderate
Short, narrow corridors or stepping stones (to prevent population sinks) with gaps <100m, or, longer but very wide landscape corridors	Meta-analysis across many studies (one Australia-specific and one worldwide), plus small number of individual studies on corridors as sinks	low
Use local-scale buffering and connectivity across large areas to support large-scale processes	No specific studies on landscape structure required for large-scale processes	high

Source: Compiled by Veronica Doerr.

3. LEARNING FROM EXPERIENCE

3.1 Lessons learnt from other literature

There is extensive technical and academic literature on the science of wildlife corridor construction and, more broadly, on connectivity science (see for example Mackey *et al.* 2010). Surprisingly, the level of socio-economic research on wildlife corridors is, with a few notable exceptions (such as the previously mentioned Worboys *et al.* 2010), absent from the academic and grey literature.

In the absence of quality literature on the socio-economic benefits of wildlife corridors, this section reviews insights from other relevant natural resource management literature. These insights are then used in Section 4 of this report.

The areas covered are multi-tenure conservation management, common-pool resource and multi-scale institutions, environmental services, and transactions costs in environmental policy.

Multi-tenure conservation management in Australia

Australia already has a history of managing for conservation outcomes across multiple land tenures through initiatives such as Biosphere Reserves, conservation networks and Indigenous protected areas (IPAs), which in turn, reflect broader influences from international experiences (Figgis *et al.* 2005). These networks are similar to the concept of a wildlife corridor in that they seek to establish a network of land managers across tenures and ownerships with other stakeholders for the purposes of achieving an overall conservation goal, but their structure and organization tends to be less formal.

The dominant conservation model of this literature is based on public reserves, with varying levels of protection, surrounded by a patchwork of conservation, buffering and linking areas on land which is privately managed and privately protected. Conservation networks vary from this model by comprising a geographically defined network of vegetation patches on private land only. This model tends to be used in highly productive agricultural landscapes where public conservation is usually minor to non-existent and too expensive. More recent contributions to the literature identify the role of other forms of tenure (such as Indigenous lands) and link to the concept of functional connectivity with the resultant wider range of land uses employed to deliver the desired conservation outcomes (see discussion in Whitten *et al.* 2011).

The composition and size of conservation networks tend to be influenced by historical factors: the rate of subdivision and intensity of land use; tenure type placed on land parcels; and by the willingness of land managers to participate in such programs (Fitzsimons and Westcott, 2007). Work undertaken by Hill *et al.* (2011b) has shown that effective conservation networks do not require a uniform institutional level of conservation protection and that a range of institutional and governance arrangements may be used to achieve conservation objectives, particularly on privately held land.

Other factors that influence network formation include the extent of remnant vegetation and the administrative boundaries of states or funding bodies. If the funding organization is state based then this can limit networks to being within state jurisdictions, even if interstate networks make sense. Interestingly, Hill *et al.* (2011b) has shown that connecting patches of protected land can be achieved with strategic investments in parcels that link important areas

of habitat. Using criteria that determine areas of high biodiversity, low protection and high threat, Hill *et al.* (2010) identified relatively modest investments in the region around Mission Beach.

Mitchell (2005) points out that, regardless of tenure and ownership (and one can add size to this list), the land has to be actively managed to achieve the conservation outcome. Crucially, this depends on the aims of landholders and their willingness to participate in conservation projects through the effective donation of their land and resources. Fitzsimons and Westcott's (2007) study into land manager attitudes within multi-tenure conservation networks found:

- The main reasons for landholder involvement were the conservation of natural assets. Other important reasons included developing associations with like-minded people and “supporting the idea of a network”
- The primary management objective was “conservation of natural assets” although promotion of sustainable agriculture/horticulture was also an important factor
- Network purpose was to protect natural areas, but other areas that receive high attention were the education of land managers and forming networks with like-minded individuals.

That is, biodiversity conservation was the primary reason for participation, but social factors were also important in land manager decisions about how and why they participate in conservation on private land.

In this context, NGOs were seen to have a positive and formative influence on network formation. Two primary areas of influence were identified, either through purchasing land in a potential biodiversity reserve area—and thus kick-start network development, or they were seen as the honest broker bringing together both the private and public stakeholders in a network.

Fitzsimons and Westcott (2007) also found that land managers identified lack of resources and time for management as the major limiting factors in involvement in the conservation network. However, the vast majority of landholders surveyed found their involvement a positive experience and about half of them either participated in networking with other land managers and/or changed their management practices.

The work of Fitzsimons (2004) and Fitzsimons and Westcott (2007) on Australian conservation networks holds many similarities to the work of Worboys *et al.* (2010) on wildlife corridor experiences from around the world. This suggests that the conclusions of each are relatively robust and transferable to different socio-economic contexts.

Common pool resource institutions and adaptive management

Sourcing the required level of resources and subsequently directing them towards achieving project outcomes is the key function of the governance regimes of wildlife corridors. Indeed, effective governance has been shown to be a key component of existing wildlife corridors (Worboys *et al.* 2010).

Creating effective and enduring governance arrangements for the management of natural resources has been extensively studied through the Common Pool Resource (CPR) literature (a subset of the institutional economics literature). More recent work in this field on the interplay between NRM governance and scale problems has also allowed for better understanding about factors that influence partnership formation and performance. Three key insights arise from this literature.

First, socio-economic and cultural institutional arrangements create the incentives that drive behaviour behind unsustainable land management decisions. These institutions can be formal (for example, laws and regulations, markets, or government programs) or informal (for example, cultural norms and tradition). They can also exist at various scales (local, regional, national or international), and a mismatch between the boundaries or influence of socio-economic institutions and the size of the biophysical problem can often be a driver of declining environmental outcomes (Cash *et al.* 2006).

The second insight is that communities are capable of self-organising and devising their own natural resource management institutions to promote and protect natural assets and promote sustainability. Extensive research in this field (for example, see Ostrom 1990, 2007) has demonstrated that there is no one correct way for communities to achieve this—the form of management and the institutional arrangements are highly culturally and contextually dependent. However, scholars have observed regularities across numerous case studies in both the enabling conditions that promote successful commons management and in the structure of the kinds of agreements reached. The enabling conditions focus heavily on the existence of strong social capital within well delineated self-managing communities, and an external institutional environment that supports the locally devised institutions (or at least does not undermine them) (Agrawal, 2001). The key feature of the structure of successful agreement is clearly defined rules over resource use/provision, that these rules are locally defined, and that there is a transparent and low cost enforcement mechanism (see Agrawal 2001).

In this literature, the recognition of the role of external supporting institutions and the cross scale nature of the incentives that drive behaviour has evolved into increasing attention on co-management and, increasingly on the area of adaptive management (together called adaptive co-management). Adaptive co-management is an approach to management and governance that explicitly seeks to recognise that natural resources, natural resource use and social drivers for resource use are inherently inter-linked in a socio-ecological system that is dynamic, multi-scalar, and inherently full of risks and uncertainties (Armitage *et al.* 2009). It views the traditional cause and effect linear approach to policy as ineffective and instead views policies as, at best, being able to develop the capacity for the socio-ecological system to be resilient (that is, adapt and transform while maintaining its inherent desirable qualities) in the face of constant change.

This complex area of literature holds several key insights for wildlife corridors:

- Resilient communities need to develop a capacity to strike a balance between maintaining integrity to core values and functions while having the ability to adapt and respond to changes in the biophysical and socio-economic environments
- Flexible and locally devised institutions are critical in developing resilience—implying that building resilience requires communities to exercise a significant amount of autonomy in determining how its resources are used
- Communities will need external support from other stakeholders. That is, they will need to work across scales to deliver on-ground projects to promote resilience. Working across scales presents local communities with both opportunities and risks. Strategies to work across these scales (for example, boundary organisations) are critical.

Ecosystem services

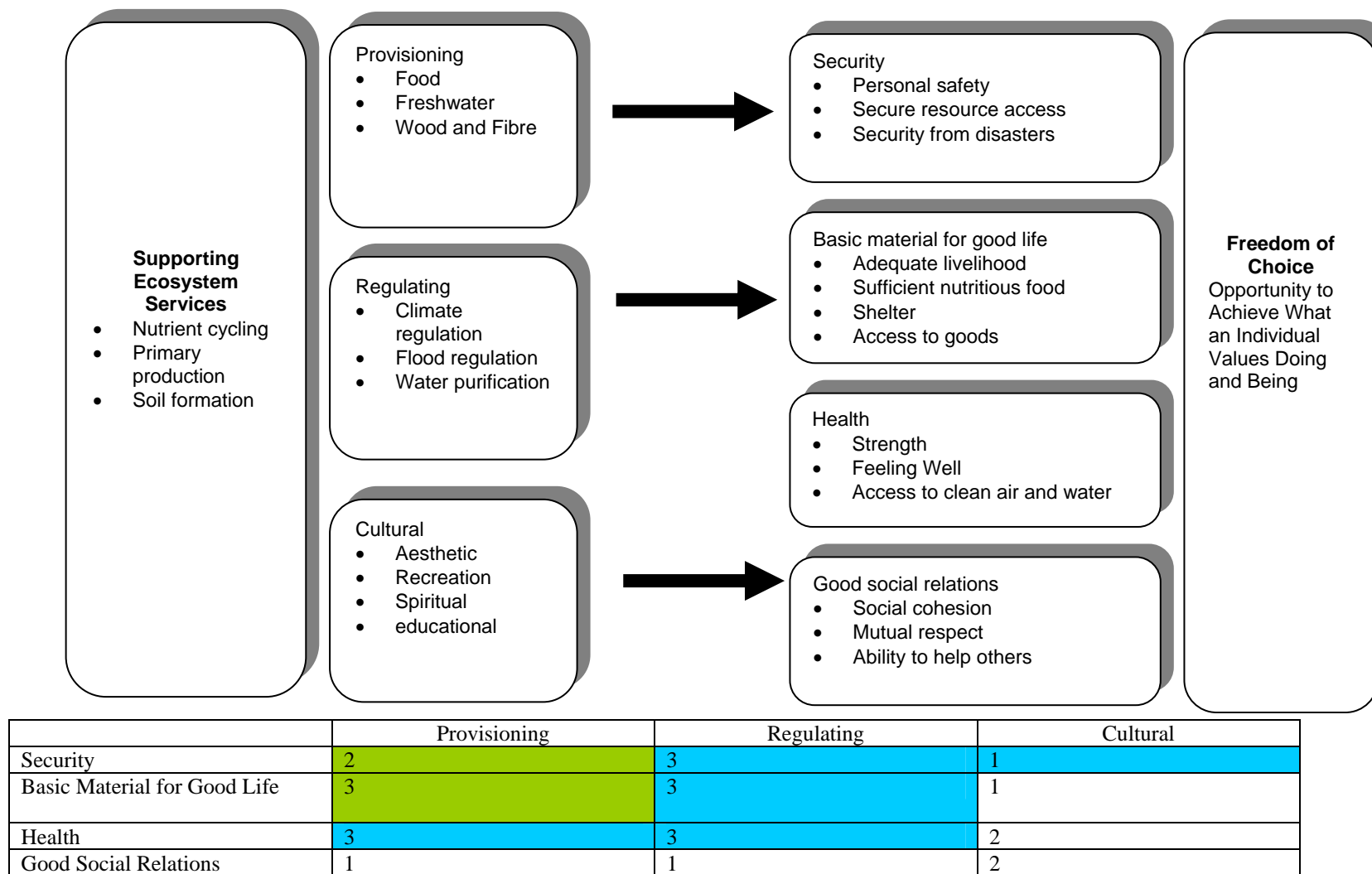
Ecosystem services are defined as: “the conditions and processes by which natural ecosystems, and the species that make them up, sustain and fulfil human life” (Daily 1997) and are generally considered of four broad types: provisioning services, regulating services, cultural services and supporting services (or ecosystem processes) (MEA 2005). The ecosystem services approach can be applied to identify the benefits (and costs) of the goods and services that are supported by connectivity conservation initiatives. The discourse around ecosystem services provides a constructive framework and language with which to engage stakeholders in the strategic and operational level planning of corridor initiatives.

The primary use of this literature is that, as a concept, the ecosystem services discourse identifies and provides language that links the state of environmental, social and economic assets to human welfare, through the everyday language of service provision. The concept is now well developed and well understood in national NRM debates (for example, ecosystem services was considered at COAG in 2007) and has been discussed extensively within state and federal bureaucracies. The ecosystem service literature offers several frameworks that can easily be adapted to the context of developing a wildlife corridor initiative (see for example MEA 2005, Samways *et al.* 2010 or the CBD ecosystem approach www.cbd.int/ecosystem/). One such framework is that developed by the Millennium Ecosystem Assessment Report whose interpretation of the basic relationships between ecosystems services and constituents of well being is set out in

Figure 3.

The Millennium Ecosystem Assessment framework provides an explicit definition of ecosystem services in a manner that is easily understood as it relates complex biophysical processes to everyday concepts (regulating services, cultural services, provisioning services), as well as drawing linkages between these services and everyday human experience (health, good social relations, security, material provisions, and freedom of choice). Scientists or other experts can then use the framework as an educational tool to present further detailed information about linkages and actions to support ecosystem services.

Through this dialogue, the “ecosystem services” concept can assist community, scientific, government and other stakeholders in identifying existing and potential ecosystem services in their natural assets, and the potential of using the wildlife corridor initiative for developing or protecting others. It also situates this dialogue within the framework of private *and* public benefits from biodiversity conservation and consequently allows a transparent examination of the relative costs and benefits borne by different parties in the delivery and/or maintenance of these ecosystem services. This analysis is critical in ensuring that the costs and benefits of collective conservation actions are, or are perceived to be, distributed fairly amongst stakeholders—a known key attribute in successful common pool resource management regimes.



Key: Colours indicate the potential for mediation by socio-economic factors. Green = high potential, blue = medium potential, White = low potential. Numbers indicate the intensity of the linkages between ecosystem services and human well-being. 1 = weak, 2 = medium, 3 = strong.

Figure 3: Ecosystem services and relationship to human well-being

Elsewhere in this report it was noted that while the protection and on-going provision of ecosystem services may be one outcome from a wildlife corridor project, in the current budgetary context, the near-term scale of investment is unlikely to deliver substantial net gain to the level ecosystem services produced (excepting biodiversity). However, where ecosystem services are considered important individual initiatives should identify and prioritise activities accordingly. Experience with using ecosystem service frameworks across Australia varies significantly, however some general observations hold a number of lessons learnt for wildlife corridor initiatives:

- Not every ecosystem service is equally important or will be part of the package of ecosystem services produced by a particular initiative or at a particular location. Conservation planning may be required to make trade-offs between them. Decisions regarding trade-offs should reflect values that are important to the community
- Threshold effects are likely to exist in revegetation activities, particularly when accounting for non-linearities in ecosystem processes and for the inter-relationships between ecosystem services. This will impact on the return on investment in revegetation activities
- Investment in ecosystem services without the requisite understanding of the underpinning ecological processes can lead to failure and a discrediting of the policy tool involved. More basic research may be required to get the outcomes needed.

Transactions costs in environmental policy

Transactions costs are defined as the cost of resources used to define, establish, maintain and transfer property rights (McCann *et al.* 2005) or are defined as all the costs that are not directly related to the production of that product (Coggan *et al.* 2010). It is a misguided perception that these transactions costs are wasted money because they are not direct expenditures on on-ground conservation works. Transactions costs are more correctly viewed as necessary expenditures to implement projects (that is, the costs of doing business) that arise because of the inherent information uncertainty involved in any transaction and reflect the activities required by individuals to manage this uncertainty (Coggan *et al.* 2010). For example, higher transaction costs can sometimes result in better targeting or more effective implementation that increases the overall benefits from investment.

A key insight in the transactions costs literature is that appropriate and efficient policy design can be instrumental in reducing transactions costs in conservation programs. This requires a reasonable understanding of the source of transactions costs in the environmental program and how these costs may change over the life cycle of the program. Several factors that drive these costs have been identified including the nature of the transactions, the familiarity of the stakeholders with the program, the characteristics of the transactions and the physical characteristics of the assets involved in the transactions (Coggan *et al.* 2010).

Transactions costs literature also argues that different actors experience these costs differently, depending on whether they are private or public stakeholders. In particular, experience in NRM projects has also shown that transactions costs are likely to fall disproportionately on a small group of stakeholders who have the requisite skills, networks and capacity to facilitate and implement a wildlife corridor initiative (in this sense they are coordination rather than transactions costs).

There is fairly limited literature of the measurement of the costs involved in transaction activities in environmental programs – with estimates conservatively ranging between 21% and 50% of project costs (Mettepenningen *et al.* 2008). This suggests that wildlife corridors may absorb a substantial proportion of funds on these “transacting activities”, which is to be expected and, to a certain extent, is the necessary cost for collaborative work. One strategy in

managing these costs is to recognize that the existing institutional structure within a community (or network) represents previous investments in the transactions costs associated with institution creation. Incorporating these existing institutions into a wildlife corridor program, rather than starting with completely new institutional building activities, will take advantage of these prior investments and reduce additional outlay on transactional activities. Another strategy is to invest in building social capital within the community or network formed to develop the wildlife corridor initiative. This activity should be designed to build trust and social relations—two factors that are known attributes in reducing transactions costs—as well as a shared understanding and shared objectives for the wildlife corridor project. Such shared understandings can reduce friction associated with managing differences in interests and program objectives between stakeholders (Hill *et al.* 2011b).

3.2 Australian wildlife corridor initiatives

This section draws on the parallel report by Whitten *et al.* (2011) to provide highlights on Australian wildlife corridor initiatives (from which more information is available). A summary of the key governance characteristics is set out in Table 3, while a summary of the implementation mechanisms used is in Table 4. Initiatives exhibit a broad level of similarity and they are largely consistent, at least on paper, with leading practice management as discussed in the various NRM literatures reviewed in this report. For example, almost all involve a partnership approach to governance, and their membership includes a diverse range of stakeholders. Many use a wide suite of policy implementation tools applied at differing delivery levels, suggesting that adaptation of the available approaches to specific contexts. While most initiatives are relatively recent, there is evident progress in building community capacity or social capital around wildlife corridor initiatives and in the articulation of clear and attractive vision concepts.

Given the relatively new nature of the wildlife corridor initiatives, it is too early to make conclusions on the lessons learnt from the Australian experience, although a number of observations can be made. The most important of these relate to whether the initiatives on-ground conservation activities are improving structural or functional landscape connectivity. Other observations include:

- There are gaps between existing mechanisms and tools that are required for successful delivery of wildlife corridors at a landscape scale. Where gaps exist, this presents an opportunity for new and better targeted instruments to emerge from wildlife corridor initiatives. Tool selection and the adaptive co-management policy cycle are discussed later in this report.
- The layering of existing on-ground conservation with a wildlife corridor initiative creates the risk of duplication between wildlife corridors and existing conservation groups. Wildlife corridors should maintain their focus on activities not currently undertaken, such as developing critical mass of resources, maintaining initiative coherence and working across scales.
- The need for improved connectivity science to reduce uncertainty around the steps to support functional connectivity and manage native vegetation in the landscape.

We previously discussed the likely existence of threshold effects in the ecological response to investment in corridors (Figure 2). The relatively small amount of funding currently available to the wildlife corridor initiative and resources made available by partner organisations are being used primarily to conduct planning (or transaction) activities. For new initiatives, achieving tangible outcomes will require the investment of sufficient funds to overcome threshold effects before significant on-ground investments are able to be made.

Table 3: Key governance attributes of Australian wildlife corridors

Governance Attribute	GER (NSW)	S2S	Habitat 141	G'Link	E-W Nature Links	Wild Eyre	Bunya Biolink	Midland-scapes	K2CCCC
Initiated (NGO, government, indigenous)	Govt	Govt	NGO	NGO	Govt	NGO	NGO	Joint	Indig.
Inclusion model (partnership, government)	P-ship	P-ship	P-ship	P-ship	Govt	P-ship	Greening Australia → P-ship	P-ship	P-ship
Membership (formal partners only, NGOs includes community groups)	NGOs Govt NFP Govt (state)	NGOs Govt NFP Research Govt (state) NRM	NGOs Govt NFP Govt (state) NRM Philanthrop	NGOs	Govt NRM boards	NRM Govt NGOs	No formal members as yet	NGOs Govt	Indig. NGOs
Governance (Incorporated, MOU, Govt)	MOU	Working group ¹	MOU → Inc.	Inc.	Govt	MOU	Greening Australia	Inc.	Indig.
Lead organisation or structure (Board, NGO, Govt, Indigenous)	Steering committee	Working group	Council and executive	Board	Govt	Working group?	Greening Australia	Board	Indig.
Hosting arrangements	NGO	Govt NFP in Uni campus	NGO	Own office	Govt. (DENR SA)	Govt. DENR Sa	NGO	NGO	Indig. In Uni Campus.
Decision model	Consensus	Consensus	Consensus	Director and Board	Govt with consultation	Consensus	N/A	Consensus	Consensus
Hierarchy?	Yes – focus regions	Yes – within GER	Yes - zones	Yes - zones	Yes	Yes – within EmW	Yes - proposed	No	Likely

Acronyms: GER (Great Eastern Ranges), S2S (Slopes to Summit, component of GER), G'Link (Gondwana Link).

Source and caveats: Whitten *et al.* (2011)

Table 4: Implementation and funding arrangements of Australian wildlife corridor initiatives

Attribute	GER (NSW)	S2S	Habitat 141	G'Link	E-W Nature Links	Wild Eyre	Bunya Biolink	Midland-scapes
Business plan	Yes	Yes (GER)	Yes	Yes	No	Yes?	No	Yes
<i>Delivery model</i>								
Coordinator	No	No	Yes	Primarily	No	Yes	No	Yes
Who are delivery agents	Partners (non-exclusive)	Partners	Partners and zones	G'Link, Zones and partners	NRM boards	Partners	GA, SEQ NRM	Midland-scapes & partners.
Manages funds	No	No	Yes (to be devolved)	Yes (new zone only)	Yes	No	Yes	Yes
Brokers covenants	Yes	Yes	Yes	Yes	No?	Yes	No	Yes
Brokers grants/programs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>On-ground mechanisms applied by partners</i> (direct or via partnerships)								
Targeted information	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Field days / workshops	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Volunteer coordination	Yes			Yes				
Field surveys/monitoring	Yes – ANU, NCT	Yes – ANU, NCT	Yes	Yes	Yes	Yes		
Covenants	Yes - NCT	Yes - NCT		Yes				
Grants (may include MBI)			Yes	Yes	Yes	Yes		Yes
Environmental markets (Carbon, offsets, other)			Yes - Carbon	Yes - Carbon			Yes – Carbon	Yes
Private purchase (land)			Yes	Yes				
Service provision (for example, fire, pest and weed)				Yes - coordinate	Yes	Yes		
Other				Yes	Yes	Yes	Yes	Yes

Acronyms: GER (Great Eastern Ranges), S2S (Slopes to Summit, component of GER), G'Link (Gondwana Link).

Source and caveats: Whitten *et al.* (2011)

3.3 International wildlife corridor experiences

Large-scale wildlife corridors are becoming an increasingly common approach in biodiversity conservation. Initiatives have been developed, and part or wholly implemented, in every continent in the world, with the exception of the Antarctic, and the concept has been adopted by the IUCN and other NGOs or intergovernmental organizations (Worboys *et al.* 2010). A recent review found over 200 ecological networks, corridors and comparable initiatives in 102 countries (Bennett and Mulongoy 2006). Consequently, there is a wealth of experience for Australian conservation practitioners to draw on to implementation based on best practice (or conversely be alert to worst practice) experiences of existing wildlife corridors projects.

A major contribution to reviewing global experiences is Worboys *et al.* (2010) book “Connectivity Conservation Management: A Global Guide” which presents a diversity of projects and significant set of lessons learnt from other projects. Three example international case studies which were selected for the variety of wildlife corridor experiences are presented in Appendix 1. The case studies along with the Australian experience appear to suggest two broad types of models for initiating wildlife corridor development. The first of these are “top down” approaches that involve the development of wildlife corridors arising out of the work of government or inter-governmental organizations. In this model, governmental or quasi-governmental planning processes incorporate biodiversity conservation goals and, through these, identify specific opportunities for wildlife corridors. Community groups, NGOs and other stakeholders are then brought on-board and educated *ex post* about the benefits of biodiversity conservation. The second type of model for initiating wildlife corridors tend to be driven by environmental NGOs that build upon existing wildlife conservation activities or initiate new activities to fulfil specific conservation management gaps unable to be carried out by national governments.

What is obvious from these case studies (as well as the ones set out in Worboys *et al.* and Worboys and Pulsford 2011), is that there is no one single way for a wildlife corridor to develop, nor is there a single model for incorporating government participation. A summary of the key lessons learnt reviewed in this book is set out in Table 6 which Worboys *et al.* consolidate into a series of tasks across foundational, delivery and cross-cutting activities (Table 5).

Table 5: Connectivity conservation management tasks

Foundational tasks	Delivery tasks	Cross-cutting tasks
<ol style="list-style-type: none"> 1. Undertake feasibility and scoping studies 2. Establish a community vision 3. Undertake pre-planning 4. Establish governance and administration 5. Establish strategic management priorities and requirements. 	<ol style="list-style-type: none"> 1. Manage finances, human resources and assets 2. Deploy instruments 3. Manage for threats 4. Assist management of incidents 5. Strive for sustainable resource use 6. Rehabilitate degraded areas 7. Provide and manage research opportunities 	<ol style="list-style-type: none"> 1. Work with partners 2. Work with stakeholders 3. Undertake communication

Source: Worboys *et al.* (2010) p. 309.

Table 6: Lessons learnt from international case studies of wildlife corridor initiatives

Objectives/Aims of wildlife corridor construction

- The primary function of connectivity conservation management should be to conserve species and maintain ecological functions/services.
- Effective connectivity conservation generally demands action at a large spatial scale.
- Connectivity conservation areas should serve multiple land-use objectives, which alongside nature conservation will often include protection of cultural places and the maintenance of ecosystem services.
- Connectivity conservation areas should be designed to have an adaptive role in countering climate change, and maximise the resilience of the present conservation network.
- Local communities need to obtain social and/or economic benefits from these initiatives.

Planning

- A clear, widely supported community vision should guide the purpose, establishment and management of connectivity conservation areas. This is a vision that expresses the joint aspirations of community and initiative leaders, managers and participants in the initiative without closing off avenues for constructive debate and disputation.
- The conservation and production values of connectivity conservation areas and their needs are unique (ecological, physical, economic and social circumstances) and this uniqueness will dictate how and what is needed to secure the site as a functional corridor.
- Planning needs to integrate across and within scales and across issues and sectors. Civil society, government, conservation and other land managers need to be part of designing, establishing and implementing connectivity conservation management and the distributional effects of decisions and actions should be part of this design and management process.
- Connectivity conservation leaders and managers need to gain an understanding of the aspirations, motivations, values and capacities of the communities with which they work. They cannot assume that people value nature. Effective social science research should therefore be part of any initiative.

Implementation and structure of physical corridor

- Protected areas should form a core component of all connectivity conservation areas.
- Connectivity conservation champions and sustained leadership are vital for achieving vision and exist at all levels. Fragmented, competitive and uncoordinated leadership should be avoided. Leadership needs to be committed for the long term.
- Connectivity conservation needs long time horizons and sustained effort to make it work.

Governance

- Good governance practice is essential for principled and effective connectivity conservation. Institutions and decision makers should have legitimacy, be accountable and transparent. Special effort needs to be made in engaging marginalised people.
- Governance should be multi-centred involving coordinating bodies, devolution to local authorities and constructive linkages with national governments. Governance for connectivity is most effective when guided by a lead coordinating and facilitating organization.

Source: Worboys *et al.* (2010)

Regardless of the broad model of development Worboys *et al.* (2010) argue that the vision for connectivity conservation is central and builds upon biodiversity conservation objectives (nature), people, and management (as illustrated in Figure 4) and is supported by four management function to lead, plan, implement and evaluate.

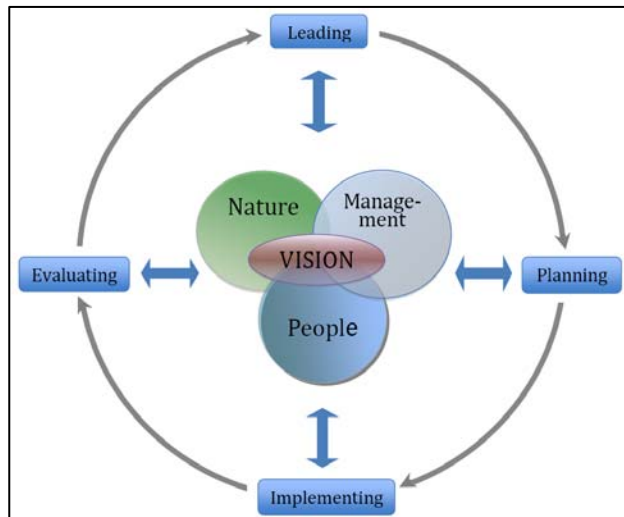


Figure 4: IUCN Connectivity Conservation Management Framework

Source: Worboys *et al.* (2010)

4. LEADING PRACTICE INVESTMENT TOOLS IN LANDSCAPE SCALE NRM PROGRAMS

4.1 What investment tools are available to deliver land use change?

The range of investment tools available to corridor initiatives is shaped by their partner members and the institutional environment in which they operate. Some of these considerations are described elsewhere in this report and are not repeated here. We note that the institutional environment suggests that new regulatory approaches are unlikely to be available to corridor initiatives. A generic description of the broad types of tools available is shown in Table 7 (with examples of these and their strengths and weaknesses provided in Appendix 2). At the outset it is worth reaffirming two aspects. First, investments should only be made where there is a clear case that the benefits outweigh the costs (which does not necessarily require a detailed cost benefit analysis—see Whitten and Coggan 2010). Second, less direct investments in removing perverse incentives, in building community support via moral suasion and social institutions, and in underpinning knowledge, can be just as valuable as direct investment in changing land management. A third factor critical to corridors is that mixed mechanisms will be essential given the multiple tenures, scales and range of management options under consideration.

Table 7: Tools and approaches for delivering connectivity actions

Intervention type	Description
Base line—status quo	Make no change if costs of change are greater than the benefit of the impact. Choice may also be to do nothing while investing in more information (per Step A in Figure 5).
Remove perverse incentives	Current policy is creating “perverse” impacts: if possible first modify or remove existing policy before considering alternative proactive mechanisms.
Moral suasion to foster social institutions or information about choices and consequences	Social pressures (social norms) are often effective where minor changes to acceptable stakeholder behaviour achieve the desired objective. Likely to be especially effective where costs are low or lack of knowledge (rather than cost) is driving behaviour.
Incentive-based approaches	Costly change (whether costs are financial, information, complexity or other) may require an incentive-based approach. Incentives may be financial or non-financial and include information provision and advice; actions which create or improve existing markets (including security of protection); and mechanisms which directly deliver an economic reward for action.
Required actions/regulations	Required actions are non-voluntary (but may sometimes be voluntarily agreed to) and usually impose a legally binding requirement on landholders. Required action approaches may be necessary when high levels of behavioural change are necessary to achieve targets.
Mixed mechanisms	There may be multiple market failures, or heterogeneous impacts of market failure which are most effectively addressed through a mixed mechanism integrating a suite of tools into a single package.

Source: Whitten and Coggan (2010).

Though not specifically targeting corridor initiatives, a range of supporting instruments are already in place in protecting biodiversity. All states have implemented regulatory instruments intended to prevent direct loss of biodiversity through landuse change and other direct impacts. Good examples

are the vegetation clearing laws intended to eliminate broad-scale clearing in each of the states (for example in NSW the *Native Vegetation Act 2003*). Similar protection is given at the national level for listed communities via the *EPBC Act 1999*. Below we discuss a range of other interventions undertaken at the national and state scale including notes on the primary delivery pathway.

Information approaches targeting improved landholder management prevalent during early phases of NRM intervention, continue to provide mechanisms for behaviour change today. These include activities such as:

- Information campaigns direct to landholders, via the internet, field days and other delivery paths. These are undertaken by government, quasi-government (CMAs, Land for Wildlife) and not-for-profit organizations such as Greening Australia
- Management advice through the 56 Regional NRM Bodies (some statutory and some incorporated) and other delivery approaches that are intended to provide a conduit for advice and funding of natural resource management to private landholders
- Demonstration projects illustrating options for improved landscape management (these were an important component of the National Landcare initiative in the late 1980s and early 1990s).

Incentive-based approaches have become increasingly important through time. Historically, major investments were a joint program between state and federal governments. However the more recent focus on grassy woodlands under the Australian Government Environmental Stewardship Program is a stand-alone national initiative. Again a variety of approaches and delivery pathways have been used including:

- Various taxation initiatives intended to reduce the cost to landholders of improved natural resource management (with relatively little uptake)
- Cost share grants which required landholders to invest a minimum amount, or proportion of total project costs. These were the favoured investment pathway during the 1990s under a range of government programs. Entry to these programs was partially first come, first served and partly competitive, favouring a mix of environmental benefits and reduced costs to government
- Non-cost share grant programs (similar in operation to previous with fixed payments)
- Incentive payments through conservation auctions, introduced most recently through the Australian Government Environmental Stewardship Program.

Other approaches applied in parallel or in coordination with regulatory, information and incentive approaches include:

- *Biodiversity offset* programs that are in place at the state level and under the *EPBC Act 1999* which require damage to ecological communities to be offset by at least an equivalent improvement in quantity or condition elsewhere
- *Revolving funds*—in place in each state providing purchase, covenant, and re-sale opportunities
- *Conservation covenants* or equivalent legal protection measures—available at the national, state and in some cases the local government level
- *Not for profit environmental groups*—prevalent but less active in agricultural settings.

The Australian Government's Environmental Stewardship program has recently shifted the emphasis for targeting investment in two ways. Firstly, this program specifically targets priority ecological communities for their conservation value and is intended to deliver an improvement in their condition

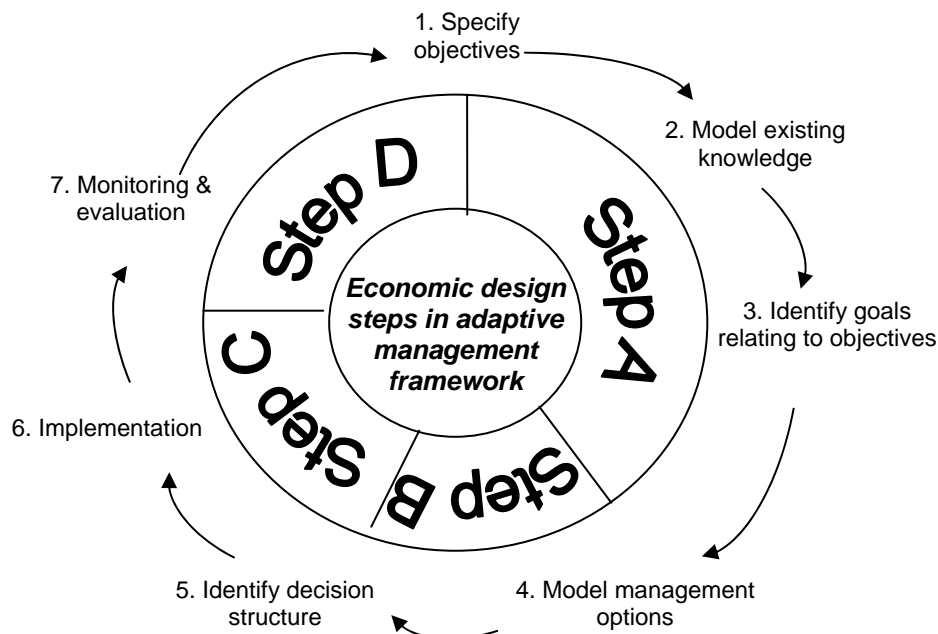
and extent. Secondly, the program has moved away from investment only within the defined ecological community towards investment in the surrounding agricultural land use matrix with the objective of improving the condition of the grassy woodland ecosystem. Future investment is likely to target landscape reconstruction with an objective of enhancing functional ecological persistence of specified meta-communities.

Deciding amongst investment options

Landscape reconstruction to ensure functional connectivity, and with that, persistence of biodiversity, is a critical task for wildlife corridor initiatives. As identified above, supporting these initiatives to maintain landscape scale patterns and processes will require active management and extend well beyond public conservation lands. The desired level of commitment, type and extent of management actions and costs are likely to be diverse. Hence, an integrated mix of tools and approaches will usually be required rather than separate, uncoordinated, actions.

An overarching conceptual framework for structuring decisions about investment tools is derived from the integration of adaptive management and mechanism design as illustrated in Figure 5 (see Whitten and Coggan 2010 for a full explanation). In Figure 5, the outer loop involving seven steps is a standard adaptive management approach to natural resource management following Bearlin *et al.* (2002) (inner feedback loops have been removed for simplicity). In the inner wheel a four step decision process for deciding and implementing investment tools is set out within an adaptive management cycle. The elements of each step within the inner wheel are summarised briefly in Table 8.

Figure 5: Integrating economic design within an adaptive management framework



Source: Whitten and Coggan (2010).

Table 8: Economic design steps via an adaptive management cycle

Step A	Step B	Step C	Step D
Resource condition and threats	Mode of intervention available	Targeting (values, stakeholders, process)	Performance measurement
Benefit/cost values (and to whom)	Market and governance failures	Design/negotiate delivery partnership	Compliance
Opportunities to manage resource	Mechanism options (how to deliver)	Effective stakeholder engagement	Evaluation
Human and institutional drivers	Ensuring net benefits result	Effective delivery process and practice	Transferring learnings

Source: Adapted from Whitten and Coggan (2010)

The process set out in Figure 5 explicitly integrates an economic design approach within an adaptive management framework. The economic design approach places emphasis on the market, institutional and related elements to support policy implementation. The integrated approach facilitates a more systems oriented approach to mechanism selection, implementation and evaluation, knowledge capture and transfer. We anticipate that Step A will be undertaken as part of the planning process within each initiative (for example, the Conservation Action Planning process is common). Parts of Step B may also be undertaken during planning processes. Similarly, while we place “design/negotiate delivery partnership” in Step C much of this negotiation may be redundant due to broader governance negotiations and decisions in Steps A and B. The challenge in supporting corridor initiatives is to generalise the leading practice approach for decisions around single, or simple instrument mixes, that we have set out above to accommodate multiple mechanisms and their interactions.

4.2 Emerging investment tools at the landscape scale

Governments are moving towards increased use of economic and market-based approaches to their investments in conserving and managing ecological services. Several changes to existing approaches are currently being discussed (and are likely to be implemented in some form) which will provide a specific focus to landscape scale mechanisms:

- *Landscape approaches to conservation auctions*: conservation auctions to date have been assessed on the basis of marginal gain at the paddock scale (that is, usually modelled improvement in condition of the specified area under contract). An alternate approach is to model the predicted marginal improvement to the probability of persistence of a meta-community or to landscape ecological health. A modified metric for conservation auctions has recently been developed that extends their focus to activities in the agricultural matrix with impacts on the specified grassy woodland site (Whitten *et al.* 2010). The revised conservation auction design will also require innovation in implementation to ensure that the ecological benefits from coordinated bids occur (for example, through some form of information feedback to landholders or a modified agglomeration bonus).
- *Extension of EPBC listing to ecosystems of national significance* (anticipated as a result of recent review): this will assist the integrated investment in meta-populations and meta-communities by encompassing the heterogeneity of vegetation communities found in landscapes and facilitate enhanced consideration of the positive and negative effects of different activities in the landscape with respect to the conservation objective.

- *The emergence of environmental markets, including carbon biosequestration and biodiversity offsets.* Many corridor initiatives and their partners are actively exploring opportunities to link participation in environmental markets to supporting conservation outcomes. A range of studies are reported in Whitten *et al.* (2011) suggesting that there is potential for carbon forestry (plantings to offset greenhouse gas emissions) to drive large-scale land use change in cleared agricultural landscapes. The potential for a profitable market for carbon forestry to reduce landscape scale fragmentation is naturally dependent on: land price, cost of planting, cost for licensing plantings for water interception, forest productivity, the discount rate and the price on greenhouse emissions. Polglase *et al.* (2011) found that of \$20/t CO₂-e, establishment costs of \$1,000 ha⁻¹ and a discount rate of 5% carbon forestry proved profitable across nearly one third of the agricultural land they evaluated, but with establishment costs were \$3,000 ha⁻¹ the profitable area fell to less than one percent. Polglase *et al.* concluded that additional incentives (for example, gap payments) may be needed to target carbon forestry in priority places to achieve other NRM objectives such as enhancement of biodiversity. Other related market activities such as revolving funds will continue to play an expanded role in connectivity initiatives.
- A related area of interest is in *environmental services markets* including restoration and fire management activities, particularly by Indigenous communities. The Office of Northern Australia is in the process of letting a tender to explore the existing and potential scale of these opportunities across Northern Australia, which will be critical to the success of initiatives across the region with important lessons for initiatives in other parts of Australia.
- *Investigation of complementary sources of income:* a number of corridor initiatives are actively exploring the potential for activities that simultaneously generate the desired biodiversity, buffering or other benefit with new sources of income. Examples include Sandalwood plantations (Gondwana Link), and initiatives being explored by Indigenous Communities in northern Australia such as bush foods.
- *Philanthropic contributions:* many corridor initiatives have received significant philanthropic contributions which have supported their initial development and planning steps (philanthropies are also partners in at least one initiative). The potential scale of philanthropic contributions is relatively unexplored. They underpin the activities of some NGO partners (such as Bush Heritage Australia) and have been significant contributors to many of the private conservation purchases within initiative boundaries.

Box: EPBC Act listing – what does it mean?

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) sets out a process for the listing of nationally threatened native species and ecological communities, native migratory species and marine species.

Once listed there is a requirement for:

- Development of conservation advice and recovery plans for listed species and ecological communities
- Development of a register of critical habitat
- Recognition of key threatening processes
- Where appropriate, reducing the impacts of these processes through threat abatement plans.

Listing under the EPBC Act provides the necessary mandate for the Australian Government to intervene directly in order to ensure conservation outcomes are achieved in the national interest.

New tools to better deliver corridor initiatives

A range of new tools will be required to better deliver corridor initiative objectives. Many of these will not yet be identified, or will be specific to context. Three areas of emphasis that have been identified are:

- *Landscape scale metrics* that are able to describe the functional connectivity benefits of different activities (and at different scales) across a landscape are essential to supporting the appropriate mix of mechanisms and to prioritising investments at multiple scales. All planning activities have at their core some assumptions about what such a metric would show. When used for planning and evaluation, the metric must be inclusive of interactions with other proposed or planned activities.
- *More flexible covenanting* or similar protective arrangements that would focus on management of buffers and attributes of functional connectivity in the agricultural matrix. Conservation covenants are generally restricted to land with high conservation significance. This usually requires that the vegetation on the property remains intact and in relatively good condition and offers high conservation value. This makes the use of conservation covenants in matrix management marginal at best. New forms of long term protection for assets such as paddock trees, and preventing threats such as fertiliser addition near environmental assets need to be designed.
- *New tools for de-intensification and supporting management* in buffering and matrix management areas. Achieving connectivity goals will require changes to management in areas adjacent to corridors to address threats and support functional connectivity, but some of these changes are different to those targeted by existing mechanisms. Permanent or long term protection is one measure. Others may require new forms of incentive programs or other yet to be developed approaches.

5. ATTRIBUTES AND GUIDELINES IN WILDLIFE CORRIDOR PLANNING

Chester (2006) argues that the concept of a wildlife corridor needs to be flexible enough to be used as a “vision” to inspire people to action, a “social movement” to inspire the flow of necessary resources and information required to achieve this vision and an “organisation” to facilitate on ground works. To address this challenge we draw on our previous discussion to first distil the attributes of successful wildlife corridor initiatives. Next we set out a draft framework describing the key institutional elements that underpin a successful wildlife corridor institution in order to guide program design. The attributes and framework are deliberately kept at a generalised level as specific program design depends on the actual context of the wildlife corridor. Implementation and management of corridor initiatives will require an adaptive co-management approach as set out in Section 5.3. The adaptive co-management approach offers the process by which the core framework elements translate the attributes identified for success into activities that deliver the corridor initiative on-ground. The proposed attributes and institutional elements set out in this section refocus the broader situational literature (such as from Worboys *et al.* 2010) to the specific needs and experiences of Australian initiatives within the National Wildlife Corridors Initiative.

5.1 The attributes of wildlife corridor initiatives

The objective for a wildlife corridors institution and the necessary attributes of such an initiative are set out in Table 9 and are discussed in detail below.

Table 9: The attributes of wildlife corridor initiatives

Wildlife corridor initiatives are:
1. Underpinned by a clearly articulated vision that sets out what is to be achieved.
2. Primarily to promote landscape resilience through connectivity conservation however they can, and should, fulfil other social and economic needs of the community.
3. Supported and implemented through an adaptive policy cycle approach to build-in learning about ecological and social systems and manage uncertainty.
4. Promoting the development of resilient human communities capable of implementing adaptive management and self-sustaining momentum.
5. Acting as boundary organisations whose purpose is to coordinate stakeholders across various scales and to facilitate the necessary flow of resources, information and skills required to conduct on-ground implementation activities.
6. Evolving toward internal rules and governance structures that facilitate, nurture and promote partnerships and collaborations across and between scales and between stakeholders with a wide variety of skill sets.

A1: Underpinned by a clearly articulated vision

A wildlife corridor vision needs to inspire people to action. It must be ambitious but regarded as achievable in the longer term with tangible and measureable shorter-term components. It must also be underpinned by convincing and compelling science. Seeking a pragmatic balance between ambition and realism should be combined with collaborative goal setting within and between the various stakeholders. The vision needs to be flexible enough to be adapted to specific circumstances, in particular, locals within the wildlife corridor geographical area.

A2: Promote landscape resilience through connectivity conservation

Resilience is the capacity of a socio-ecological system to absorb shocks and perturbations and maintain function; a resilient system has a capacity for renewal and reorganisation (Folke, *et al.* 2002). Corridors, by providing evolutionary scale connectivity, are expected to enhance resilience of species and ecological communities to climate change and other threats. The scale and complexity of corridor initiatives will require cross-scale management, grappling with uncertainty and risk, the use of local knowledge, and incorporating cultural values in order to manage resilience. Activities to build resilience may be used to boost the capacity for a community and the landscape to adapt and transform to changes in the natural or social environment without losing the intrinsic values identified as important. As an example of this type of resilience thinking see Walker *et al.* (2009) applied to the Goulburn Broken Catchment.

A3: Supported and implemented through an adaptive approach

Adaptive co-management is an approach that is designed specifically for managing complex systems under uncertainty as is the case with connectivity and corridor management. Traditional management approaches are focused on outputs, efficiency and physical sustainability. Adaptive co-management incorporates these concepts into a broader framework placing equal emphasis on social and ecological systems. Adaptive co-management is based in an understanding of the underlying processes that create particular outcomes and in managing risks to the ecological system that underpins the wildlife corridor, the social system that creates and supports a wildlife corridor and the relationship between them. Key features of an adaptive co-management approach are:

- Use of an adaptive policy cycle for learning about the ecological and social systems of a wildlife corridor and ‘updating’ decisions in light of this information. This allows both systems to adapt and transform in the face of changes and is the central component in promoting resilience (Charles, 2004, Folke *et al.* 2002).
- Collaboration between networked stakeholders that operate across various temporal, jurisdictional, spatial and knowledge scales.
- A focus on using the wildlife corridor to manage human and natural risks rather than optimising the size of the activities for the sake of it.

A4: Promote the development of resilient human communities

The core business of wildlife corridors is the promotion of landscape resilience (particularly to the challenges posed by climate change) through biodiversity conservation. Co-delivery of social and economic benefits, alongside biodiversity conservation outcomes, can and should be an integral part of a wildlife corridor initiative. This is important in building community support for biodiversity because it provides tangible benefits associated with the project.

To engender ownership in projects, communities should select the particular type of social and economic co-benefits to best suit their local circumstances. While ecosystem services may be one type of socio-economic benefit generated in the community, opportunities should exist to allow communities to select benefits that lie outside the direct scope of the wildlife corridor.

A5: Corridor initiatives to act as boundary organisation

The wildlife corridor should be established as a boundary or “umbrella” organization. The most important role of a boundary organisation in a corridor initiative is to act as a coordinator, link and facilitator across the corridor region and interested stakeholders. Key characteristics of a boundary organisation include (see Cash *et al.* 2003):

- Accountability to all stakeholders
- The use of information such as supporting material such as maps, reports, and forecasts that are understood or co-produced by all stakeholders
- Participation and involvement of all stakeholders
- Translation of different perspectives and mediation between stakeholders.

These boundary organisations, and the strategic partnerships and relations they develop are dynamic. It is expected that they will evolve in response to specific circumstances and needs of participants and to different life cycles of the project. The fluid nature of these relationships may cause the operation of a wildlife corridor to appear unstable, inefficient and somewhat chaotic. Rather, this is a sign that the institutional arrangements are responding to community needs and opportunities.

Initiatives will need also to complement and work with existing NRM institutions (who are obvious partners). The wildlife corridor initiative will also act as the political and public face of biodiversity conservation in the region. The structure of a model wildlife corridor institution is illustrated in Appendix 3.

A6: Facilitate, nurture and promote partnerships and collaborations

Shared trust between stakeholders is fundamental to collaborative conservation (Leach *et al.* 2002). Key mechanisms to develop this trust and through that, build social capital are:

- A transparent governance structure with a free flow of information between stakeholders
- Membership of initiatives open to all interested parties
- A collaborative approach to priority setting using co-research tools such as scenario building and analysis, joint research projects, and recognition of local knowledge and experience.

It is unlikely that on-ground community groups, or the wildlife corridor secretariat, will have sufficient financial, human or technical resources to implement all the necessary on-ground conservation works. A primary task in facilitating conservation works is the development of strategic partnerships between on-ground groups, responsible for implementation, and partner organizations who have the capacity to provide a range of supports to the initiative. In developing these strategic partnerships, the wildlife corridor secretariat, and its community groups, should keep in mind that:

- A wide variety of strategic partnerships may be required to fulfil specific capacity gaps in on-ground delivery
- Strategic partnerships may need to be developed with more than one partner to fulfil a specific need in the projects
- Partnerships are dynamic and will change over time as parts of the wildlife corridor initiative are completed or new opportunities for partnering arise
- Therefore, clear internal rules and governance structures are necessary for organisational stability, transparency, and effective operation of what may be substantial operations involving large investments, multiple staff, and multiple, potentially competing, stakeholders and relationships.

5.2 Draft framework for developing wildlife corridor initiatives

Initiators of wildlife corridors are required to resolve a complex set of management tasks:

- Undertaking and completing the required science to map out and plan for the biophysical characteristics of the wildlife corridor and social science to understand the socio-economic characteristics of the region
- Development of an institutional structure and process for governing the initiative
- Building the relationships with communities and strategic outside partners
- Building a collaborative vision of project aims, goals and objectives
- Securing the appropriate project finance, technical resources and information and monitoring resources.

The idealised model of a wildlife corridor is conceptualised as a boundary or umbrella organisation: focused on developing intra- and cross-scale partnerships to implement on-ground community supported projects. The wildlife corridor, as an institution, comprises five elements: a membership or stakeholder base; a set of agreed rules and governance processes for governing the initiative; a decision making body (inclusive or exclusive, formal or informal such as a steering committee, working group or board); a secretariat or host; and a range of external project partners responsible for at least some aspects of on-ground implementation. An overview of the key functions of each element is set out in Table 10 with the relationships between stakeholders shown in Appendix 3.

Table 10: Institutional elements of wildlife corridor initiatives and their function

Wildlife corridor institution elements	Some key functions
Membership or stakeholder base (includes land managers, community groups, local NGOs and others—see Whitten <i>et al.</i> 2011)	<ul style="list-style-type: none"> • Identification of aims and objectives • Participation in the development of the wildlife corridor vision and strategic plan • Identification of local socio-economic benefits to be co-delivered with the wildlife corridor project • Source stakeholder representatives to decision making body • Provision of a volunteer conservation work force • Provision/donation of in-kind resources (for example, equipment) • Provision of local ecological knowledge to broader wildlife corridor planning and scientific assessment and monitoring • Completion of planning for the “localisation” of the wildlife corridor initiative • Permission to incorporate private land into the wildlife corridor initiative (landholders)
Rules and governance (partly following Ostrom 2007)	<ul style="list-style-type: none"> • Structure, roles and limitations of initiative (including who can participate) • Operational rules for making day to day autonomy and decisions • Collective choice rules for strategic decisions and rule changes • Constitutional rules setting out the agreed roles and responsibilities of stakeholders for participating in the initiative • Basis for accountability of the initiative to stakeholders and others (including internal monitoring and sanctioning process)
Decision making body	<ul style="list-style-type: none"> • Coordinate development of overarching vision • Aggregation of local planning processes and development of wildlife corridor strategic plan • Forum to plan coordination between stakeholders and joint projects • Forum for all stakeholders to share information, views, resolve conflicts etc. • Public face of wildlife corridor initiative—used to approach external project partners to seek support and resources.
Secretariat or host	<ul style="list-style-type: none"> • Performs secretariat functions for the wildlife corridor board of management • Coordinates activities with communities to co-develop wildlife corridor vision and strategic plans • Undertakes activities to facilitate linking of local stakeholders with external project partners.
External Project Partners	<ul style="list-style-type: none"> • Works with wildlife corridor board and individual local conservation groups • Provision of scientific knowledge, skills and technical know-how—used in planning and implementation processes • Implement projects within the corridor initiative • Provision of financial resources • Assists in changing policy settings (if this is required).

5.3 Steps in an adaptive co-management cycle

Adaptive co-management links community, scientists, resource users, government managers, and other stakeholders in a collaborative problem-solving environment (Armitage *et al.* 2009). The adaptive co-management approach offers the process by which the core framework elements translate the attributes identified for success into activities that deliver the corridor initiative on-ground. Emphasis is placed on design and delivery as a learning process. This learning process is part of a cycle—information that is learned through doing conservation work is fed back into the policy development cycle in order to update assumptions and data sets for future decision making purposes (that is, the system “adapts”). This adaptation cycle is a central component in building resilience in a social context.

In a management context, the adaptive co-management policy cycle is represented as a series of steps for managers to follow in implementing a conservation project. Numerous models have been developed for adaptive co-management, but recent CSIRO research has evaluated and found to be effective a community based policy cycle designed specifically for landscape conservation (Hill *et al.* 2011c). We combine Hill *et al.* with the work of Whitten and Coggan (2010) to distil six implementation steps which reflect many of the principles and issues raised throughout this paper. These steps overlap with the more biophysically oriented CAP process that many corridor initiatives have already employed within Australia. Additional tools supporting this process are described in Appendix 4. Our model draws out and emphasises the importance of the social and governance aspects and should be viewed as supporting and developing existing approaches rather than replacing them.

1) Exploratory analysis of the natural resources and human community.

Hill *et al.* (2011b) emphasises social and cultural values around land use, biodiversity conservation and management. An economic perspective extends analysis to the institutional and economic factors that influence the biophysical problem, such as:

- The source of market failure or regulatory failure leading to land clearance or insufficient biodiversity conservation provision;
- Commodity markets that drive decisions about food and fibre production in the landscape;
- Real estate markets underpinning land values;
- Local planning regulations and state and national planning regulations; and
- Skills audit of the local community to determine the priorities for on-ground support.

2) Facilitation of community ownership and a shared community vision.

Hill *et al.* (2011b) use this approach to creatively engage stakeholders, overcome conflicts, and to generate intervention options. An important part of building this community consensus will require analyses of conservation benefits and beneficiaries, including whether they are public benefits or private benefits. Similarly, such analyses should identify the costs involved in delivering the wildlife corridor vision and how these costs are distributed within the community.

3) Identification and prioritisation of strategies and projects.

Hill *et al.* (2011c) focus on building a process that identifies both culturally and biophysically important species conservation models. Work by Whitten and Coggan (2010) suggests that a third step be added—identification and evaluation of policy intervention tools. Thus, this stage of wildlife corridor development can be summarized as:

- Biophysical and spatial prioritization using frameworks such as the Conservation Action Planning (CAP) Process (summarized and discussed in Whitten *et al.* 2011) or the focal species approach discussed in Hill *et al.* (2011b)
- Culturally and socially valuable species and biodiversity assets, using Hill *et al.* (2011b)
- Policy intervention tools, commensurate with the biodiversity objectives and sources of funding for the project (for example, public/government, philanthropic or carbon markets). Section 4 provides a starting point (see also Whitten and Coggan, 2010).

Although these stages are presented sequentially, this is not a linear process. In practice it is likely that identification of the physical and social factors that determine conservation priorities occur simultaneously and inform each other. Similarly, identification of specific policy tools may help refine the scope and scale of the biophysical area, as budgets and other project resources are identified.

4) Forging of implementation partnerships

Hill *et al.* (2011b) emphasise the central role of partnerships in the adaptive co-management framework—implemented using tools such as scenario building or the collaborative investment atlas (see below). Scaling up this approach to wildlife corridors is likely to need additional tools to overcome institutional fragmentation risks that can act to dilute the capacity of the wildlife corridor to translate their planning into effective on-ground works.

5) Designing and negotiating the internal rules of operation

The wildlife corridor initiative needs an agreed set of rules amongst the participants that set out the boundaries of activities and thereby potential membership, the rules of engagement amongst the participants, including how decisions are to be made, and what rights and obligations members are willing to cede to the initiative or retain (broadly per Ostrom 2007). These rules of operation create the corridor as a social institution and govern its activities as an organisational entity.

6) Updating and refinement.

A boundary or umbrella organization that acts as the “secretariat” to the project becomes the champion of this process. Transaction costs associated with boundary organisations are relatively high in the short run compared to more traditional approaches. However, longer term benefits associated with significantly higher community support, social capital and multi-sector pay-offs are likely (Hill *et al.* 2010, Armitage *et al.* 2009).

Embedded in this approach is a philosophy that encourages innovation, flexibility and experimentation in delivery instruments, target activities, modes of delivery and so on. To fulfil this potential, all stakeholders involved, and in particular public funding bodies, need to adopt an open-minded and flexible approach that cedes control over on-ground works to those conducting the activities, and permits the possibilities of failure. Failure in this sense is the failure of a particular on-ground implementation activity and not the whole wildlife corridor, or adaptive co-management approach, itself. Rather, failure is a necessary aspect of learning, and in the iterative adaptive co-management framework seen as simply one stage in the continual cycle of learning and intervention.

Focus on building ecological and social resilience

The adaptive co-management policy cycle described above sets out a potential plan of action for the planning and implementation of a wildlife corridor. Use of a resilience approach in this process will require research to explicitly focus on understanding the underlying processes and drivers of the ecological and social systems that support a wildlife corridor, and for implementation activities to actively manage risks that arise.

The following questions, developed by Gale *et al.* (2010) can help ensure that the process implemented, be it built around CAPs or some other approach, incorporates resilience concepts:

- 1) What are the specific threats or disturbances in the natural resource condition that have an impact on the ecological or socio-economic values as identified by the community?
- 2) What are the thresholds relating to these specific threats or disturbances?
- 3) Are the planning, management and monitoring strategies being implemented in such a way that wildlife corridor participants can learn about important system dynamics (that is, thresholds, alternate states, drivers, feedback etc....)?
- 4) Can the lesson learnt from the research/implementation be used to inform future decision making?

Many existing corridor initiatives have also built other forms of institutional resilience into their organisational structure and strategies (sometimes termed building social and human capital), many of which are likely to be necessary features of adaptive co-management approaches on the scale of connectivity corridors for biodiversity. Design or evaluation questions incorporating resilience elements can similarly be built into the adaptive co-management cycle at a strategic evaluation level. While such questions will necessarily be tailored to the forms of resilience that are considered most important to individual initiatives some common components will be:

- 5) Has any redundancy been deliberately built into the system (to cope with loss of key staff, failure of key initiatives, loss of a key partner and so on)?
- 6) Are there rules for changing operational or other rules when the unexpected happens?
- 7) Are there appropriate system checks and balances in place to ensure due discipline and accountability?
- 8) Have multiple funding sources been sought?
- 9) Are a targeted range of delivery instruments, deliver modes, or other delivery options employed?
- 10) Is knowledge held centrally or widely distributed?
- 11) Is there preparation for extreme but possible events (fire, flood, cyclone etc.)?

6. KEY MESSAGES

The information set out in Whitten *et al.* (2011) and this report demonstrate the presence and effectiveness of large-scale wildlife corridors in the Australian NRM landscape. Their success requires a broader change in NRM thinking from opportunistic “place” and “asset” type conservation activities to strategic conservation planning focused ecological process in order to facilitate landscape scale resilience against a variety of threats, including climate change. New government initiatives in this area will, therefore, not be starting from a clean slate, rather they will need to seek how best to support an existing, and rapidly developing, movement of community groups, state governments, NGOs and academic groups.

We identify six key messages from our research:

1. *Social and economic benefits and costs at scale:* Corridor initiatives have the potential to deliver substantive connectivity conservation benefits across large-scale objectives in a cost-effective manner. They are unlikely to have substantive adverse impacts on local economies. Nor, with the exception of the environmental sector, are they likely to generate substantive positive economic impacts in isolation from other initiatives. They are likely to deliver substantive social benefits, especially in the environmental sector. There is potential for additional ecosystem service benefits from corridor initiatives but a number of assumptions would need to be met for these to be large.
2. *Social and economic benefits and costs at the project level:* Corridor initiatives will have substantive impacts on some, relatively small parts of landscapes. The desired connectivity management activities will have direct impact on these landholders that may involve a range of income reducing responses. In some cases additional management costs will also be incurred.
3. *Social and economic risks:* Corridor initiatives face a range of risks, primarily resulting from their organisational structure and relationships (institutional proliferation, fragmentation and conflict) and from the underpinning knowledge base (limitations to landscape ecology science and other barriers to implementation).
4. *An adaptive co-management approach* is proposed as an overarching framework for considering and implementing wildlife corridors.
5. *Implementation of an adaptive co-management approach should cover six elements:*
 - Exploratory analysis of the natural resources and human community
 - Facilitation of community ownership and a shared community vision
 - Identification and prioritisation of strategies and projects
 - Forging of implementation partnerships
 - Designing and negotiating internal rules of operation
 - Updating and refinement.
6. *Implementation will require a range of overlapping approaches* that will need to be integrated in order to be both engaging across the breadth of community diversity and to avoid duplication. These include:
 - Community engagement processes to define vision and create ownership:

- Prioritisation, planning and adaptation—using tools such as the CAP process discussed in Whitten *et al.* (2011).
- Identification and selection of investment tools.

The social and economic lessons that can be learnt from corridor initiatives to date, along with an in depth analysis of theory and evidence of multi-partner large-scale NRM were synthesised into a proposed set of six overarching attributes that all corridor initiatives should be comfortable with as objectives.

Wildlife corridor initiatives are:

1. Underpinned by a ***clearly articulated vision*** that sets out what is to be achieved.
2. Primarily to promote ***landscape resilience through connectivity conservation*** however they can, and should, fulfil other social and economic needs of the community.
3. Supported and implemented through an ***adaptive policy cycle*** approach to build in learning about ecological and social systems and manage uncertainty.
4. Promoting the development of ***resilient human communities*** capable of implementing adaptive management and self-sustaining momentum.
5. Acting as ***boundary organisations*** whose purpose is to coordinate stakeholders across various scales and to facilitate the necessary flow of resources, information and skills required to conduct on ground implementation activities.
6. Evolving toward internal rules and governance structures that ***facilitate, nurture and promote partnerships and collaborations*** across and between scales and between stakeholders with a wide variety of skill sets.

Finally, we suggest that corridor initiatives embed a resilience focus across their vision, organisational structure, and implementation approaches. The importance of different corridor initiative elements to resilience will vary but should encompass biophysical (conservation) design, institutional or rules governing the initiative, organisational structures and processes, and engagement with the wider community and economy.

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APPENDIX 1: THREE INTERNATIONAL CONNECTIVITY CORRIDOR CASE STUDIES

Yellowstone to Yukon initiative

Often cited as a leader in connectivity conservation, the Yellowstone to Yukon Initiative (Y2Y) extends from west-central Wyoming to the Yukon's MacKenzie Mountains, spanning five US states, two Canadian provinces, two Canadian territories, and the traditional territories of 31 First Nations groups, across approximately 1.2 million square kilometres of mountainous terrain (Schulz and Bass 2008). Y2Y stretches 3200 km in length and ranges from 200-800 km wide, corresponding with the ecological boundaries of the eastern-montane foothills and western inland-coastal watersheds (Schulz and Bass 2008). Y2Y emerged from the Wildlands Network, an NGO initiative established in 1991. This network has grown to include eight "Megalink" corridors, which include "core wild areas", "wildlife linkages" and "stewardship lands" (The Wildlands Network 2009). Y2Y has been solely funded through philanthropic contributions, and it is driven by NGOs in both Canada and the US with very little government involvement.

The success of the Y2Y has been largely attributed to its captivating landscape vision. The overarching vision encompasses people working in collaboration to maintain and restore the area in the corridor. The presentation and elaboration of this vision plays on the iconic images of Yellowstone National Park and the Yukon Territories while incorporating the mission of the initiative and its scientific principles (Chester 2006). However, despite its iconic place in connectivity conservation, a recent Masters Thesis reviewing the initiative found that in spite of the captivating vision, a lack of clearly defined goals and objectives had hindered the progress of Y2Y (McGregor 2003). McGregor also found that Y2Y had prioritised ecological goals over social dimensions of conservation, has been unable to attract a diverse stakeholder base and it is not yet functioning effectively at multiple scales. In the early years, Y2Y was heavily driven by biocentric values which provoked a strong backlash from those communities across the region dependent on resource extraction for their livelihoods (Chester, 2003;2006).

Originating out of an alliance between scientists and activists, Y2Y began as a loose coalition of concerned individuals and organisations and has since become an independent incorporated association "The Yellowstone to Yukon Conservation Initiative" (Y2YCI). An important distinction to make is that between Y2YCI and the Y2Y initiative that represents a network of partner organisations working towards the Y2Y mission. There has been no significant government or industry involvement in Y2Y, with the network comprised primarily of environmentally focused NGOs. Within this network, the Y2YCI functions as a catalyst and facilitator, which oversees the big picture and promotes the vision, and raises funds to be redistributed through the network through a series of partner grants programs. Y2YCI does not get involved in on ground operations, rather it partners with other organisations who implement the vision.

Greater Cederberg Biodiversity Corridor (GCBC) and Cape Action Plan for the Environment (CAPE)

Covering 1.8 million hectares, the Cape Action Plan for the Environment (CAPE) is a systematic conservation plan and conservation strategy for the Cape Floristic Region (CFR) in South Africa. The Plan was initiated as a "top down" proposal through funds provided by the Global Environment Fund in 2000, which has subsequently has been adopted by the South African Government. A key emphasis of CAPE is collaboration across different sectors, primarily conservation, agriculture and land-use planning (Sandwith *et al.* 2005) Within the

CAPE, the Greater Cederber Biodiversity Corridor promotes stewardship philosophy with a focus on the responsibility of landholders and agencies to care for the land on behalf of society. The project has a strong focus on the role of people in conservation and the corridor is conceptualised as a “lived in and worked in” landscape (GCBC undated).

The strategy is underpinned by an ecosystem approach to conservation that recognises institutional fragmentation as a significant impediment to biodiversity conservation. A key component of the project is the intention to strengthen the institutional frameworks for coordinated conservation in the region. There are two tools used in the GCBC: area wide planning and incentives for conservation. The area wide planning framework is grounded in participatory local decision making, action and management which seeks to find agreement among stakeholders working in the region. The incentives for conservation are based on stewardship mechanisms developed within the region through pilot studies that build on a tradition of landholder involvement in and establishment private reserves and conservancies (Sandwith *et al.* 2010). Three mechanisms are offered with increasing limitations on land-use: conservation sites, biodiversity management agreements/cooperation agreements and contract nature reserves. The contract nature reserves have the most stringent requirements and are akin to a formal protected area. The stewardship mechanisms include financial assistance, management advice and assistance in developing strategies to manage fire and invasive species (Sandwith, *et al.* 2010).

At the overarching level, key political and implementation partners in the CAPE have signed formalized agreements on priorities for funding, alignment and facilitation. Nested beneath these agreements, the GCBC partnership involves both government and non-government organisations as well as conservation agencies and is managed as an informal alliance of regional and local interests with a statutory conservation agency (CapeNature) taking on the role of coordination and integration of management within the corridor. CapeNature functions as a service provider covering planning, operations and administration for the Steering Committee who represent stakeholder interests. The GCBC has formalised implementation strategies coordinated through the institutional framework of the GCBC and supported by the higher-level vision and strategy of the CAPE. These partnerships and mechanisms for coordination have been central to cross sectoral and cross scale conservation action within the GCBC and the CFR (Sandwith *et al.* 2005).

Panthera

Panthera is an international NGO that works across Africa, Asia and North and South America to promote the conservation of 37 wild cat species. Started in 2006, the aim of the organization is to “*save all wild cat species across their ranges, and to do so in a scientifically rigorous and sustainable manner*” (Kaplan, 2010). Panthera runs programs under 6 different themes of genetic mapping of wild populations, GIS mapping and remote sensing of ranges, training and capacity building, promoting conservation policy, promoting and creating conservation media (for awareness raising), education and outreach, community based conservation and construction and management of wildlife corridors (Panthera, 2011). Specific wildlife corridor and community conservation projects are:

- Jaguar Corridor Initiative (South America) – including Rancher Outreach program.
- Project Leonardo – focuses on African lion conservation in Tanzania, Uganda, Zambia, Nigeria, Zimbabwe, Mozambique, Democratic Republic of Congo and West Africa. This initiative includes “Lion Guardians” a community based project in Kenya engaging Masai communities for African lion protection.
- Snow Leopard Program – working across Mongolia, China, Tajikistan, Pakistan and India.

- Tigers Forever – working in India, Myanmar, Thailand, Lao PDR, Malaysia and Indonesia on Asian tiger conservation.

Panthera works to directly implement projects, to conduct scientific research and to undertake capacity training with communities. Panthera engages with, and relies on, stakeholders across scales and organizational types (government, academia, local NGOs, fundraising NGOs, IUCN, zoological societies) to deliver specific aspects of projects. The nature of the partnership relation is tailored to the particular circumstances of the project, but often with Panthera acting as the “catalyst” organization and/or facilitating an “upscaling” of corridor/conservation initiatives.

In its work on international scale corridor initiatives (for example, the Jaguar Corridor across central and south America) Panthera develops specific modes of operation within each country to meet the particular circumstances of the location. Panthera thus serves to both provide a coordinating vision for the entire corridor, as well as adapting it to localised conservation contexts. It also seeks to draw together the ecological benefits of biodiversity conservation with tangible economic and social benefits for the local communities – often in innovative ways. For example, in the Pantanal area of the Jaguar Corridor (northern Brazil), Panthera works with health providers to establish health clinics for the local community and uses them to deliver health services, as well as educational materials about the benefits of jaguar conservation (Panthera, 2011).

APPENDIX 2: MECHANISMS FOR DELIVERING LANDUSE CHANGE

Some common mechanisms and approaches and design rationale

Intervention type	Example approach	Typical market or regulatory failures addressed
Remove perverse incentives	Remove tax concessions, subsidies on undesirable activities	<ul style="list-style-type: none"> • Reduce regulatory failure from financial distortions and misalignment of incentives resulting from government policy • Reduce regulatory failure from institutions via reduced support for potentially damaging activities or investments (for example, based on business type).
	Remove rule or institution advantages to potentially damaging investments	
Moral Suasion	Foster consumer / lobby group	All are designed to substitute or supplement market signals to encourage land manager behaviour:
	Government advertising	
	Pro-social rewards	
Incentive based no financial payment	Information advice & support	<ul style="list-style-type: none"> • Primarily intended to overcome poor or asymmetric information and thereby facilitate market provision. • Assist in reducing transaction costs and inexperience in mechanism as constraints.
	Non-financial material assistance	<ul style="list-style-type: none"> • Provides a surrogate market signal usually via reduced biodiversity management costs. • Can help overcome capital entry constraints.
	Security / protection of actions	Assists in defining rights or entitlements to future management and use and specifically in excluding particular options.
Incentive based financial payments	Financial assistance	<ul style="list-style-type: none"> • Financial assistance provides a market signal overcoming excludability and providing a market place. • Agreement or contract clarifies rights and entitlements. • Can be structured to overcome capital entry constraints and principal agent problems.
	Competitive allocation	<ul style="list-style-type: none"> • Market signal, clarifies rights/entitlements, entry constraints and principal agent problems as above. • Metric reduces measurement issues and may support information measures.
	Purchase (with/without resale)	Provides a market signal, creates a market place and can assist in overcoming thin markets and can reduce impact of information failures and asymmetries.
	Prohibition / Regulation on inputs, process or end products	<ul style="list-style-type: none"> • Clarifies rights and entitlements through exclusion, prohibition or obligation. • May reduce information failures depending on design.
Required actions (primarily regulations)	Regulation with compliance flexibility	May offer reduced regulatory failure compared to above.
	Mandatory certification	<ul style="list-style-type: none"> • Reduces information failures and asymmetric information by signalling impacts or outcomes in market. • Clarifies rights by imposing a minimum standard (duty).

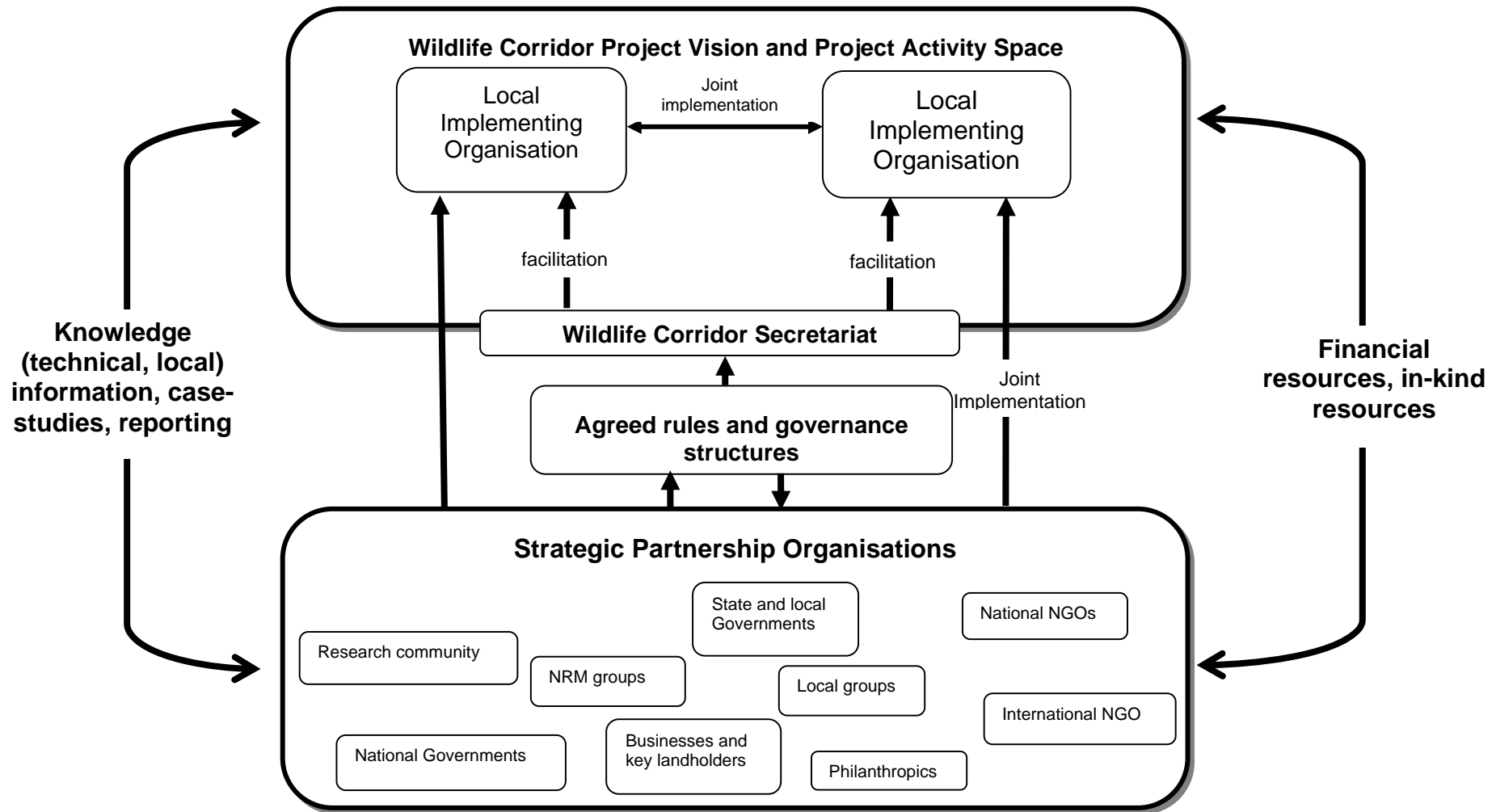
Source: Whitten and Coggan (2010)

Some strengths and weaknesses of alternative intervention types

Intervention type	Strengths	Weaknesses
Remove perverse incentives	Low cost (may actually save money) Discourages damage Often precursor for other interventions	May (re)create other policy problems Usually does not reward actions
Moral suasion	Low cost Ongoing and self enforcing Consistent with societal expectations Simple to design and implement	Low incentive / penalty No formalised requirements Usually slow to impact Only likely effect small changes
Incentive based no financial payment	Often low cost Ongoing and cost reducing Can influence beliefs and expectations Usually simple to design and manage Voluntary	Unlikely to be effective if net costs high Few or no formalised requirements Advisory rather than enforceable Slow to impact
Incentive based financial payments	Flexibility in engagement Encourages change Encourages innovation / improvement Accepted by industry Payments may overcome larger costs Immediate impact on behaviour	No mandatory requirements Cannot enforce outcomes May be costly if payments large Cost / complexity in managing contracts Only some will change management
Required actions (primarily regulations)	Minimum performance Mandatory compliance Implies polluter pays Capable of near universal change May be cheap for government Faster impact on behaviour	Often inflexible for targeted stakeholders Incentives to avoid penalty not improve outcomes Usually input or processed-based Costly to enforce / requires enforcement Often opposed by industry Imposes costs on participants
Mixed mechanisms	Can overcome multiple impediments Can appeal to broad constituencies	Additional complexity, cost and potential for unexpected interactions

Source: Whitten and Coggan (2010)

APPENDIX 3: RELATIONSHIPS BETWEEN STAKEHOLDERS IN THE WILDLIFE CORRIDOR



APPENDIX 4: ADDITIONAL TOOLS FOR BUILDING COLLABORATIVE NETWORKS

Hill *et al.* (2010) incorporate a range of collaborative tools into their adaptive co-management approach to biodiversity conservation in the Mission Beach Area of Far North Queensland. These tools are:

- Collaborative focal species;
- Scenario analysis for community visioning;
- Institutional brokering tool through brokering scientific partnerships and joint development of research outputs – for example, joint mapping exercises; and
- Project implementation partnerships and joint monitoring.

A summary of these tools are set out in Table A4. Details about these tools can be found at Hill *et al.* (2011b). These tools are focused on building a collaborative vision for biodiversity conservation between different stakeholders by seeking to integrate the different knowledge bases used by each group and to integrate the institutional arrangements in order to overcome institutional fragmentation. While research into the efficacy of these tools are on-going, the manner in which they are developed makes them flexible enough to adapt to different biodiversity conservation contexts.

Tools for implementing the adaptive co-management approach

Tool	Description	How it is used
Collaborative focal species	Framework for identifying species that encapsulate three values in the landscape: social significance to local community, cultural significance to local Indigenous communities and an ecologically significant species who can act as an indicator of healthy biodiversity.	Chosen species is used as a symbol to engage community with positive images of biodiversity protection. Assists in identifying knowledge uncertainty in the community and by scientists – for example, community survey” reveal lack of general understanding between cassowary survival and habitat protection.
Scenario analysis for community visioning	Process for identifying “future states” using the following steps: 1. Identification of the focal issues 2. Assessment of the current system, key drivers of change/uncertainties, measures of effectiveness, potential thresholds for regime shifts; 3. Identification of possible alternatives; 4. Building of spatially-explicit scenarios; and 5. Analysis of scenarios and recommended policy choices.	Facilitates development of shared vision and therefore overcoming conflicting community perceptions, goals and aspirations. Encourages participants to evaluate values and assumptions about the state of future. Effectiveness of scenarios promoted through focus on three factors in scenario stories: (1) the focus on threat; (2) biodiversity science integration; and (3) simplicity in presentation.
Institutional brokering tool (brokering scientific partnerships and joint development of research outputs – for example, joint mapping exercises)	A range of activities to bridge the gap between scientists and practitioners for the purpose of over coming barriers to uptake by conservation practitioners of the scientific research. The focus of is the development of the collaborative habitat investment atlas (CHIA). The CHIA is a compendium of information that incorporates “biodiversity value, costs of land for acquisitions, costs of incentives, protection available through land-use planning, land-owner willingness to be involved, levels of entrepreneurship, social capital and burnout in rural communities” The CHIA information is converted into visual tools based on three criteria and weightings: biodiversity sensitivity, level of protection and threat.	The CHIA is used to integrate social and ecological data to support prioritisation of investments by stakeholders. Visual presentation, and the ability to alter weightings between values and options translates scientific knowledge into language lay people can understand and facilitates discussion about investment options.

Source: Hill *et al.* (2010, 2011b).



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