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Climate-ready conservation objectives: a scoping study

Final Report

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and Frederieke Kroon

CLIMATE-READY CONSERVATION OBJECTIVES: A SCOPING STUDY

CSIRO Climate Adaptation Flagship

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ABSTRACT

Anticipated future climate change is very likely to have a wide range of different types of ecological impact on biodiversity across the whole of Australia. There is a high degree of confidence that these changes will be significant, affecting almost all species, ecosystems and landscapes. However, because of the complexity of ecological systems and the multiple ways climate change will affect them, the details of the future change are less certain for any given species or location. The nature of the changes means that the multiple ways biodiversity is experienced, used and valued by society will be affected in different ways.

The likely changes present a significant challenge to any societal aspiration to preserve biodiversity in its current state, for example, to maintain a species in its current abundance and distribution. Preserving biodiversity 'as is' may have been feasible in a stationary climate (one that is variable but not changing), but this will not be possible with the widespread, pervasive and large ecological changes anticipated under significant levels of climate change. This makes the impacts of climate change quite unlike other threats to biodiversity, and they challenge, fundamentally, what it actually means to conserve biodiversity under climate change: what should the objectives of biodiversity conservation be under climate change? And what are the barriers to recalibrating conservation objectives?

Based on key insights from the scientific literature on climate change and biodiversity, the project developed three adaptation propositions about managing biodiversity:

1. Conservation strategies accommodate large amounts of ecological change and the likelihood of significant climate change–induced loss in biodiversity.
2. Strategies remain relevant and feasible under a range of possible future trajectories of ecological change.
3. Strategies seek to conserve the multiple different dimensions of biodiversity that are experienced and valued by society.

Together these propositions summarise the challenge of future climate change for biodiversity conservation, and define a new way of framing conservation we called the 'climate ready' approach. In the near term, conservation strategies may be able to include some consideration of these propositions. However, under significant levels of climate change many of the current approaches to conservation will become increasingly difficult and ineffective (e.g. maintaining community types in their current locations). This challenge is fundamentally different from that posed by other threats to biodiversity, and the climate-ready approach is akin to a paradigm shift in conservation.

The project used a review of 26 conservation strategy documents (spanning scales from international to local) and four case studies with conservation agencies to test and refine the climate-ready approach. The project found the approach to be robust and highly relevant; in the majority of situations, if adopted, it would lead to significant changes in the objectives and priorities of conservation. There were also many 'green shoots' of elements of the new approach in existing conservation practice. However, the project found there are currently substantial barriers to fully adopting a climate-ready approach. These include the need for:

- further development of ecological characterisation of ecosystem health and human activities in landscapes
- much better understanding of how society values different aspects of biodiversity, including ecosystems and landscapes
- development of policy tools to codify and implement new ecologically robust and socially endorsed objectives.

EXECUTIVE SUMMARY

Climate change is likely to have significant future impacts on biodiversity globally and across the whole of Australia; there is already considerable evidence that Australian fauna and flora are responding to the relatively small climate changes that have occurred. A wide range of different types of future impacts on biodiversity have been described, including changes in the genetics, abundances and distributions of species; novel combinations of species; changes in ecosystem structure, function and composition; and changes in landscape patterns of ecosystems and land uses. The multiple ways the different aspects of species, ecosystems and landscapes that are experienced, used and valued by society across the whole continent will be affected as these ecological changes occur.

Collectively, these changes present a significant challenge to any societal aspiration to preserve biodiversity in its current state, for example, to maintain a species in its current abundance and distribution, or to maintain the distribution of types of ecosystem across the landscape. Preserving biodiversity ‘as is’ may have been feasible in a stationary climate (one that is variable but not changing), but this will not be possible with the pervasive and large ecological changes anticipated under significant levels of climate change. This makes the impacts of climate change quite unlike other threats to biodiversity. As a result, we are forced to consider what it actually means to conserve biodiversity: what can conservation management feasibly seek to achieve, and why?

This project set out to explore the extent to which existing approaches to conservation might be ready for significant levels of climate change, and to scope the issues involved in developing strategies that are feasible and effective in the future. The project used the notion of the ‘objectives’ of conservation, or the desired outcomes for biodiversity, as a way of testing the potential effectiveness of strategies and to gauge the extent to which the implications of climate change were embedded in conservation thinking and decision-making. The project also developed the concept of a ‘climate ready’ conceptualisation or framing of conservation, which integrates three essential issues that together differentiate between the conservation task under significant climate change and that in stationary climates.

Drawing from a synthesis of the literature on climate change and biodiversity, the climate-ready framing is based on three propositions that describe how a set of conservation strategies may need to be calibrated to accommodate the future impacts of significant climate change.

Adaptation proposition 1: Conservation strategies accommodate large amounts of ecological change and the likelihood of significant climate change–induced loss in biodiversity. This challenge suggests that the role of conservation needs to be recast from preventing change to ‘managing change in order to minimise loss in those aspects of biodiversity that are valued by the community’. This can be conceptualised as managing an inevitable transition from the current state of biodiversity to a more preferable, rather than a less desirable, version of a future state. The task of resisting change from the current state is seen as ecologically infeasible.

Adaptation proposition 2: Strategies remain relevant and feasible under a range of possible future trajectories of ecological change. The multifaceted and complex nature of future climate and ecological change make it impossible to predict with confidence the details of these future states, yet in many situations management to reduce future loss may be required before the actual trajectories are apparent. Strategies therefore need to be cast to be effective under a wide range of different types or scenarios of ecological change.

Adaptation proposition 3: Strategies seek to conserve the multiple different dimensions of biodiversity that are experienced and valued by society. The multiple ways society experiences and values biodiversity will be affected in different ways, and this will vary between ecosystems and across the country. Proxies for multiple values, and narrowly framed metrics of biodiversity value, therefore risk being much less effective under climate change, and there is an increasing risk of perverse outcomes from such approaches. In particular, threatened species and ecological communities are likely to become less effective as a tool for conserving the gamut of ways biodiversity is experienced and valued by society.

The climate-ready framing suggests conservation strategies need to consider each of these propositions, *and* they need to move away from the existing 'static' versions of them, such as seeking to preserve communities in situ. Thus, adopting the climate-ready framing is akin to a paradigm shift in conservation planning, not merely an evolution.

The framing was used in a review of 26 conservation documents and in four case studies with conservation agencies. The purpose of the review and case studies was to assess the extent to which conservation in Australia is already consistent with the climate-ready framing, and to scope some of the key ecological, social and institutional issues involved in incorporating this approach into conservation decision-making. The documents spanned international, national, state, regional, local and non-government organisation (NGO) scales and a range of document types, including conventions, legislation, strategies and plans; these provided a very wide sampling of current conservation practice in Australia. The case studies enabled more detailed exploration of the consequences of the framing with greater reference to the thinking and operational contexts of current conservation. The review and case studies were also used to test and refine the concepts forming the climate-ready framing. The project then developed a prototype tool and a set of prototype objectives to help natural resource management (NRM) planners and conservation decision-makers understand and explore the implication of the climate-ready framing.

The review and case studies found the climate-ready approach to be robust, revealing how relevant the core concepts are to conservation and how, if adopted, the framing could lead to significant changes in objectives and priorities. Some consideration is already being given to issues underpinning the climate-ready framing, through concepts such as resilience and 'Limits of Acceptable Change' (LAC). However, the static paradigm is well entrenched in current conservation practice as well as the relevant science and social narratives, and there are substantial barriers to fully adopting the climate-ready approach. These include the need for:

- further development of ecological characterisation of ecosystem health and human activities in landscapes
- much better understanding of how society values different aspects of biodiversity, including ecosystems and landscapes
- development of policy tools to codify and implement new ecologically robust and socially endorsed objectives.

1. INTRODUCTION

The potential for climate change to have significant impacts on species and ecosystems in Australia and around the world is becoming very clear (Dunlop et al. 2012; Steffen et al. 2009; Hughes 2000). This has led to significant research on the potential options for addressing various impacts on biodiversity (reviewed in Hagerman et al. 2010a; Heller and Zavaleta 2009; Mawdsley et al. 2009). While the magnitude of change is beginning to be more widely recognised and acknowledged in science and policy, there remains a gulf between recommendations for 'adaptive management approaches', 'resilience' and 'ecological processes', and the articulation of tangible and practical objectives that can be readily adopted in policy (Dunlop et al. 2012; Pittock and Finlayson 2011; Boer 2010; Heller and Zavaleta 2009; Steffen et al. 2009). This challenge is highlighted in numerous recent assessments of biodiversity policy at national, state and regional levels (e.g. *Australia's Biodiversity Conservation Strategy 2010–2030*[1], the *Murray–Darling Basin Proposed Basin Plan*, *Vulnerability of Tasmania's Natural Environment to Climate Change: An Overview*, *Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015*).

It is also becoming more apparent that the task of responding to climate change impacts might be more complicated than just implementing new or improved management actions. In particular, there is concern that existing conservation objectives may not be effective under the significant levels of environmental change anticipated under future climate change scenarios. Preliminary work has demonstrated that accommodating climate change could lead to significant changes to objectives that result in practical differences in conservation priorities (Dunlop et al. 2012; Williams et al. 2012a; Pittock and Finlayson 2011; Prober and Dunlop 2011; Boer 2010; Hagerman et al. 2010b; Dunlop and Brown 2008). However, the ecological concepts, social mandate and institutional tools required to develop and implement very new objectives are not well established, and the revision task may take a decade or more (Dunlop et al. 2012). This report seeks to begin this process of revision by presenting a theoretically sound case for change; a framework for assessing how effective biodiversity conservation objectives might be under climate change; and a tool to help managers begin the task of developing conservation objectives, strategies and planning processes that might be more effective under significant levels of future climate change. We describe such conservation strategies as being 'climate ready'.

1.1 Project overview

The purpose of the research project was to understand the scope and complexity of revising biodiversity conservation objectives so they are effective (and achievable) under climate change, and to raise awareness of the strategic implications of climate change among biodiversity planners and managers. The project also aimed to learn from national, state and regional biodiversity managers as they used their experience and innovation to respond to the challenge of developing conservation strategies that accommodate significant levels of climate change. This objective of the project was realised through four interrelated strands of work.

1. Development of a robust rationale for developing climate-ready biodiversity conservation objectives

Understanding the implications of climate change for biodiversity conservation policy and planning is a new and evolving area of research and practice. Crafting a future biodiversity management system that simultaneously facilitates change while protecting critical values will result in new approaches to conservation. To support this new field of

[1] All conservation documents referred to are referenced in Appendix 1 to maintain textual flow.

research, this report argues for a new framing of the task of conserving biodiversity in the face of significant climate change. The case presented is theoretically sound, conversant with the ecological science literature and the emerging literature on climate adaptation and informed by practice and experiences of on-ground experts. It provides the basis for beginning a conversation about the future of biodiversity decision-making and supports the development of practical tools to assist policymakers and planners consider the implications of climate change for biodiversity and its conservation.

2. Review and assess existing conservation objectives in Australia

The purpose of the review and assessment of current strategic conservation documents[2] is to understand the extent to which existing biodiversity conservation and natural resource management (NRM) goals and objectives understand and incorporate the impact of climate change into conservation strategies and decision-making. In particular, the review examined whether recent developments in conservation – such as approaches focusing on resilience, ecosystem processes, landscapes, and so on – adequately address climate change. The review provides valuable insight into the extent to which current conservation thinking and decision-making in Australia might be ready for future climate change, and the barriers to adopting the climate-ready approach. The review was the first part of the scoping activity in this project.

3. Case studies testing the climate-ready approach with biodiversity conservation agencies

Four case studies were conducted with innovative practitioners to explore the implications of the climate-ready approach for conservation decision-making, barriers to its implementation and the solutions to these barriers. The case studies also helped refine the concepts underpinning the approach and enabled a more detailed analysis with greater reference to the thinking and operational contexts of conservation decision-makers at various scales. They also acted as a knowledge transfer mechanism between researchers and practitioners. The case studies form the second part of the scoping activity for this project.

4. Development of a tool and prototype objectives to assist in the development of climate-ready biodiversity conservation objectives

Bringing together the theory, key insights from relevant ecological literature and the insights from the review and case studies, this research started development on a self-assessment tool aimed at regional NRM planners to help them explore the climate-ready approach – and its significance for strategies and objectives – as an adjunct to their existing planning processes. A prototype set of climate-ready objectives was also developed to illustrate the concepts and some of the challenges that might be encountered in implementing them.

1.2 Report structure

The initial chapters in the report develop the building blocks for articulating, describing and using a climate-ready framework for biodiversity conservation and management in Australia, and the final chapters integrate these and provide some further directions. Chapter 2 sets out the theoretical framework for a climate-ready approach and develops a set of climate-ready criteria for assessing conservation objectives.

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[2] For the purposes of this report we use ‘conservation documents’ to include all types of strategic conservation documents such as international conventions, legislation, policies, strategies, and so on, in contrast to documents focusing on implementation.

These criteria are then used in Chapter 3 (review and assessment of existing strategic conservation documents) and Chapter 4 (case studies with four conservation partners) to validate and refine the concepts behind revising conservation objectives.

Chapter 5 focuses on the task of helping conservation and NRM planners become familiar with the concepts needed to understand the implications of climate change for conservation. It does this through development of a prototype tool for developing climate-ready conservation objectives. Chapter 6 concludes the report by identifying the next steps and research needs.

2. BACKGROUND: CLIMATE CHANGE, BIODIVERSITY AND CONSERVATION OBJECTIVES

This chapter sets out the conceptual framework used in the project. First it summarises some key aspects of what is known about how climate change will affect biodiversity. Second, it develops these into three propositions about adapting conservation to climate change, leading to our ‘climate-ready conceptualisation of conservation’. Third, it discusses translating these propositions into conservation objectives.

2.1 Impacts of climate change on biodiversity

There is significant evidence that Australian fauna and flora are already responding to changes in climate over recent decades (Williams et al. 2012a; Steffen et al. 2009; Hughes 2000). A wide range of different types of future impacts on biodiversity have been described, including changes in the genetics, abundances and distributions of species; changes in the interactions between species; novel communities resulting from species responding in individual ways; changes in ecosystem structure, function and composition; and changes in landscape patterns of native ecosystems and land and water uses (Dunlop and Brown 2008).

Recent continental analysis of the sensitivity of biodiversity to climate has revealed just how widespread and significant in magnitude future climate change may be on Australia’s biodiversity (Hilbert et al. 2012; Ferrier et al. 2012). Drawing on these analyses, the literature and ecological analyses in four biomes, Dunlop et al. (2012) concluded that anticipated levels of climate change could lead to most places in Australia having, by 2070, environments that are more ecologically different from current conditions than they are similar.

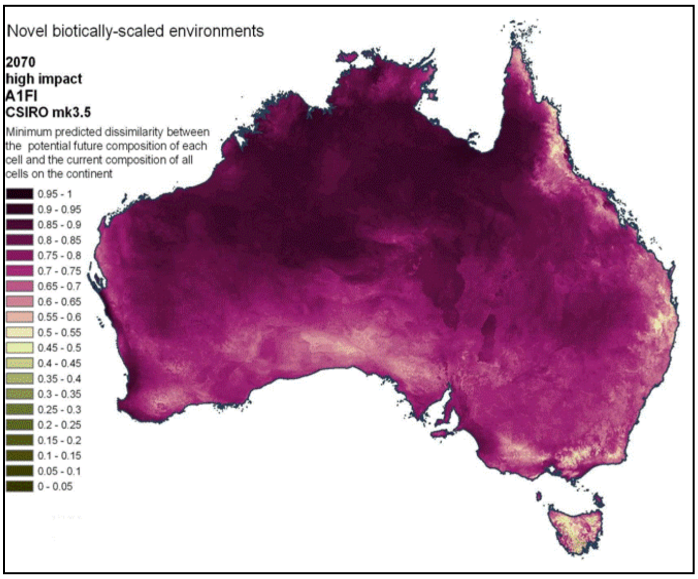

Figure 1: The potential future extent of environments not currently experienced by biodiversity in Australia

Green indicates the potential occurrence of future environments that are ecologically similar to current environments. Purple indicates the potential occurrence of future environments that, by 2070, are ecologically dissimilar to environments currently occurring anywhere in Australia. Under a medium impact scenario, novel environments are still likely to cover more than half of the continent.

Source: Dunlop et al. 2012

Given the unique combinations of climatic, soil and other environmental conditions that affect the distribution of plants and animals, it is most likely that climate change will lead not only to shifts in suitable habitats, but also to the large-scale disappearance of many existing environments and the emergence of new and novel environments (e.g. Figure 1). In short, the current state of scientific research globally and in Australia is robust enough to support the conclusion that climate change could lead to widespread environmental change that is very ecologically significant (Dunlop et al. 2012).

It is very difficult to predict in detail the net outcomes from climate change for any species, ecosystem or place due to the large number of possible responses of species and ecosystems to climate change, the inherent uncertainty in some aspects of future environmental change, and the interacting nature of many ecological changes (Dunlop et al. 2012; Williams et al. 2012a; Steffen et al. 2009; Dunlop and Brown 2008). Indeed, a range of contrasting types of ecological change may dominate in any one situation depending on the ecological change, sensitivities of biodiversity and other geographic factors, as illustrated in Table 1. These scenarios highlight that changes affecting species, ecosystems and landscapes could be significant, and that there is no one simple way to characterise the likely impacts on biodiversity.

Table 1: Contrasting scenarios of possible ecological changes for different dimensions of biodiversity

Dimension of biodiversity	Scenarios of ecological change
Species outcomes	• *In situ adaptation:* Species either unaffected, cope, adapt in situ, adapt locally (within their existing distributions), evolve; possibly with reduced abundance and range. • *Regional shifts:* Species disperse and establish at new sites matching their regional bioclimatic habitat; possibly declining in areas of pre–climate change distribution. • *Coping with new species:* Species colonise from elsewhere, some altering habitat and species interactions, altering the realised niche of resident species; possibly contributing to reductions in the abundance and range of resident species.
Ecosystem outcomes	• *Change in composition:* Loss of species and establishment of new species; potentially reducing local species richness and diversity; structure and function may or may not change significantly. • *Change in structure:* Changes in the relative abundance or dominance of species lead to change in habitat structure; potentially resulting in a simplification of habitat; may or may not include changes in composition and function. • *Change in function:* Changes (loss) in net primary productivity, for example, as a consequence of change in function due to changes in environmental potential or abundance of producer species and food-web interactions; productivity possibly below its potential.
Landscape outcomes	• *Change in type of ecosystems and land/water uses:* Changes in land, water, and sea uses and changes in types and functioning of ecosystem; but not necessarily the net balance; potentially including loss of particular ecosystems or services. • *Intensification of land/sea use:* Less hospitable matrix for species and ecosystems as land uses intensify and agro-ecosystems expand; may happen rapidly in response to technology and climate adaptation opportunities; likely to include loss and degradation of supporting habitat for species and ecosystems. • *Expansion of land/sea use:* Potentially more hospitable matrix and reduction in extent and intensity of land, water, and sea uses; in response to decreased productivity of fisheries, grazing, cropping systems, etc; reduced water availability; potentially leading to increased habitat availability for native biodiversity, but land abandonment may be preceded by degradation.

Source: after Dunlop et al. 2012 and Williams et al. 2012a

While the scenarios in Table 1 are not mutually exclusive, a single scenario could certainly dominate in any given situation for a given dimension (i.e. species, ecosystems or landscapes). Of these scenarios, the second one for the species dimension – regional shifts in species distributions – is the most familiar, and often the only scenario considered in discussions about adapting biodiversity management (Loss et al. 2011; Roberts et al. 2011; Yamano et al. 2011; Minteer & Collins 2010; Walther 2010; Walther et al. 2005). However, there is very good evidence, from a wide range of ecological literature, for the feasibility of each of these scenarios, and each scenario could lead in separate ways to losses of valued aspects of biodiversity.

Biodiversity is already experiencing significant pressure from non–climate change pressures, such as habitat loss, degradation, fragmentation and invasive alien species (SoE 2011). As well as having direct impacts, climate change will interact with many other pressures affecting biodiversity, potentially leading to combined impacts much greater than the sum of each individually (Driscoll et al. 2012). However, climate change is qualitatively different from other types of pressure on biodiversity because of the extent of the ecological impacts (simultaneously affecting all locations, species and ecosystems across the whole continent) and the magnitude of the changes (such that the 'pre-European baseline' and current states of biodiversity both cease to be reasonable reference points for policy or management).

Three key conclusions can be drawn from the understanding outlined above of how biodiversity may be affected by climate change–driven changes to the Australian environment.

1. The magnitude of future ecological change could be substantial, including changes in the species assemblages and ecosystem types occurring at given locations.
2. Substantial uncertainty about many details of future ecological change is likely to persist.
3. Many different aspects of biodiversity will be affected, including species, ecosystems and landscapes.

While the nature of the environmental and ecological changes will vary between taxa and across Australia, we suggest these three conclusions are likely to apply to the vast majority of situations, representing the rule rather than the exception. Further, these three conclusions each have the potential to have significant implications for conservation strategies and, in particular, the setting of conservation objectives in policy statements and planning processes.

2.2 Implications for conservation strategies

The analyses described above, by others in Australia (e.g. Steffen et al. 2009) and globally, strongly indicate climate change has substantial implications for conservation. There is a rapidly growing scientific literature that suggests how specific conservation practices might be modified, or new approaches developed, frequently focusing on assisting the movement of species across landscapes and regions (reviewed in Hagerman et al. 2010a; Heller and Zavaleta 2009; Mawdsley et al. 2009). In addition, various studies and surveys of experts and practitioners have suggested that current frameworks for conservation, and in particular the objectives of conservation, may need to be reassessed (Dunlop et al. 2012; Lemieux and Scott 2011; Pittock and Finlayson 2011; Boer 2010; Hagerman et al. 2010a, 2010b; Heller and Zavaleta 2009; Steffen et al. 2009; Dunlop and Brown 2008).Despite this awareness there has been very little exploration of how climate change might affect *what* conservation is trying to achieve as opposed to *how* it achieves its objectives (Dunlop et al. 2012; Prober and Dunlop 2011; Hagerman et al. 2010b).

Over the last two decades, approaches to conservation have evolved in response to increasing understanding of the magnitude and complexity of the problem and the systemic nature of the drivers of biodiversity loss. This has included increasing focus on motivating conservation on private land, landscape-scale ecological processes and resilience. However, although not explicitly articulated, the overarching biodiversity conservation framework in Australia, and globally, has been developed with an expectation of relatively stationary climates (variable, but not changing) and relatively low levels of threat (Hagerman 2012b). The implicit ecological assumption flowing from this is that the species and ecosystems that might be expected to occur at any given location in the future are those that have occurred there in the recent past, and that species extinctions could be halted or kept to a very low level. While these assumptions may have been useful in the past, there is little doubt they are now deeply challenged by what we know about the pervasive nature of climate change impacts and biodiversity's large sensitivity to it, especially in combination with other pressures. As a consequence, we argue that conservation needs to be reframed to address the challenges of climate change, including reassessing the nature of the biodiversity outcomes society is seeking from its conservation investments.

The following sections discuss the potential implications of climate change for conservation strategies and planning. Taking the three conclusions about climate change as the starting point, we go on to formulate these into 'adaptation propositions' that describe key characteristics of conservation strategies and planning processes that might be more effective under significant levels of future climate change.

These adaptation propositions were used as preliminary adaptation criteria in the review of existing conservation documents (described in Chapter 3) and the agency case studies (Chapter 4) to help assess existing conservation objectives, test the relevance and validity of the propositions, and refine them as adaptation criteria.

2.2.1 Distinguishing between ecological change and loss

Given the potential magnitude of future climate change and the sensitivity of biodiversity to this change, future trajectories for biodiversity can best be characterised as including significant amounts of change resulting inevitably in substantially different ecological states and conditions (Dunlop et al. 2012). Attempting to prevent these changes would require intensive intervention, and in most situations it would be infeasible or impossible. Further, where rates of environmental change exceed the ability of biodiversity to adapt there will be losses in biodiversity, for example, extinction of species, decline in locally important species, impacts on valued aspects of ecosystems and landscapes, and reduction or loss of many ecosystem services with resulting social and economic impacts (e.g. Williams et al. 2012b). While it is impossible to predict in detail, given the rate, magnitude and pervasive nature of climate impacts and the interacting effect of existing other pressures on biodiversity, losses to biodiversity and associated values could be substantial.

The prospect of continuing climate change therefore recasts the task of biodiversity conservation from one of 'preventing change' to one of 'managing change' in order to 'minimise loss' in those ecological properties that are valued by the community (Dunlop and Brown 2008). Under significant levels of climate change, this can be conceptualised as managing the inevitable transition from the current state of biodiversity to a future state so that a more preferable version of that inevitable future state results as opposed to a less desirable alternative (Figure 2).

Reducing the change from the current state might be possible by reducing the rate and magnitude of climate change through managing global greenhouse gas emissions. However, *resisting* change from the current to the future biodiversity state through ecological management is seen as ecologically infeasible. It may even be counterproductive. An example of resisting change might be sacrificing one wetland by diverting flows to temporarily maintain the historical hydrological regime of another, instead of managing each so they both adapt to changing hydrological regimes as the climate dries. Similarly, effort spent restoring habitat in situ for a particular species that eventually shifts in distribution or becomes extinct might be better spent establishing ecosystems that persist as the climate changes and provide habitat for future species. This model highlights the need for suitable management of the changes in ecological states to reduce the loss associated with those changes. In some situations such management may be required decades before changes in biodiversity are realised, for example, restoring habitat with species that will survive future climates.

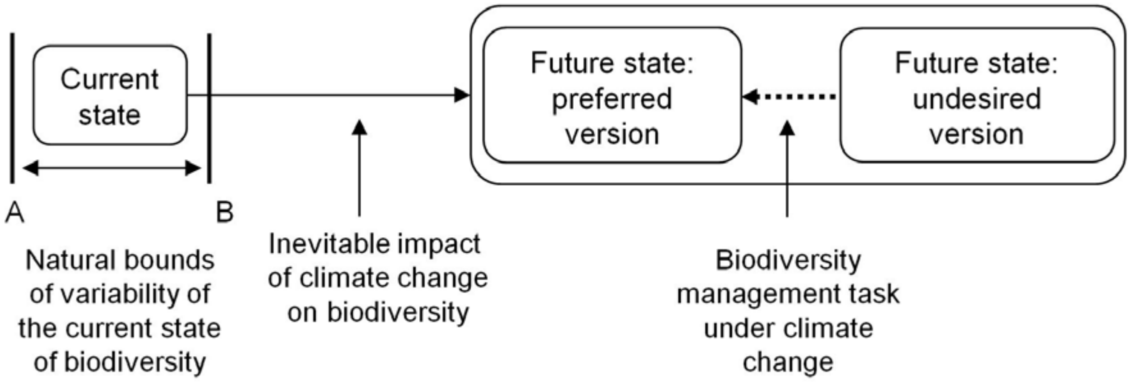

Figure 2: A simple model of large and inevitable climate-driven ecological change, with the dashed arrow defining the conservation task

The figure depicts the state of biodiversity at a single future point in time. In the event that global atmospheric greenhouse gas concentrations are not rapidly stabilised, the trajectory of change is likely to be more continuous and the model can be generalised to seeking a preferred version of an ongoing trajectory of change.

Variability in climate and the response of biodiversity to this variation are key features of Australian ecosystems and landscapes. Recent adaptive management and resilience approaches seek to accommodate such variation while retaining the defined ecological state, character or identity of the system. This could be done by identifying thresholds of potential concern (represented by the distance A to B in Figure 2). Under climate change, significant directional ecological change will add to the variation and eventually move systems beyond their current bounds, essentially to new states. While it is desirable that these new states are themselves resilient, this is different from maintaining the resilience of the current state *against* climate change.

Explicitly implementing this concept of biodiversity conservation in strategies would involve articulating the difference between those properties of an ecological entity or system for which change might be regarded as *loss*, and those properties for which *change* might be regarded as undesirable under a stationary climate but acceptable under climate change.

> *Adaptation proposition 1: Conservation strategies accommodate large amounts of ecological change and the likelihood of significant climate change–induced loss in biodiversity.*

2.2.2 *Addressing uncertainty*

The simple model above (Figure 2) depicts a single trajectory of change with management affecting which version of a single future state is realised. However, in most situations key elements of the trajectory of ecological change are likely to be unknown (at least at the current time) due to uncertainty in the details of climate change (e.g. rates of temperature increase, changes in rainfall) and the complex and interacting nature of ecological responses. A range of different trajectories of change are likely to be possible; dealing with such uncertainty is a systemic issue in climate adaptation (Williams et al. 2012a; Allen et al. 2011; Stafford Smith et al. 2011; Dunlop & Brown 2008). Some of this uncertainty is articulated in the scenarios of possible ecological change in Table 3. This complicates conservation policy and the setting of strategic objectives even further. A more realistic representation of the future conservation task would include multiple different trajectories and future states, each with a preferred version and less desirable version (Figure 3). We label this model, combining a large magnitude of ecological change and uncertainty in the trajectory or end state, the 'dynamic conceptualisation of biodiversity conservation'.

Multiple possible trajectories of ecological change might occur, for example, when the future locations of a species' most suitable habitat is unknown due to uncertainty about its sensitivity to climate change; or where fire frequency could increase due to more frequent hot, dry weather or decrease due to less biomass production. Where only a small number of discrete trajectories or states are possible, it may be feasible to set future objectives for each. However, in most situations it may be necessary to set objectives that consistently represent the preferred version of any possible future state, for example, maintaining a certain level of structural diversity or richness of native species, without specifying the particular communities or species present. This might involve describing desired ecological outcomes using ecological properties that are different from those currently used to describe systems of interest, be they species, ecosystems or landscapes.

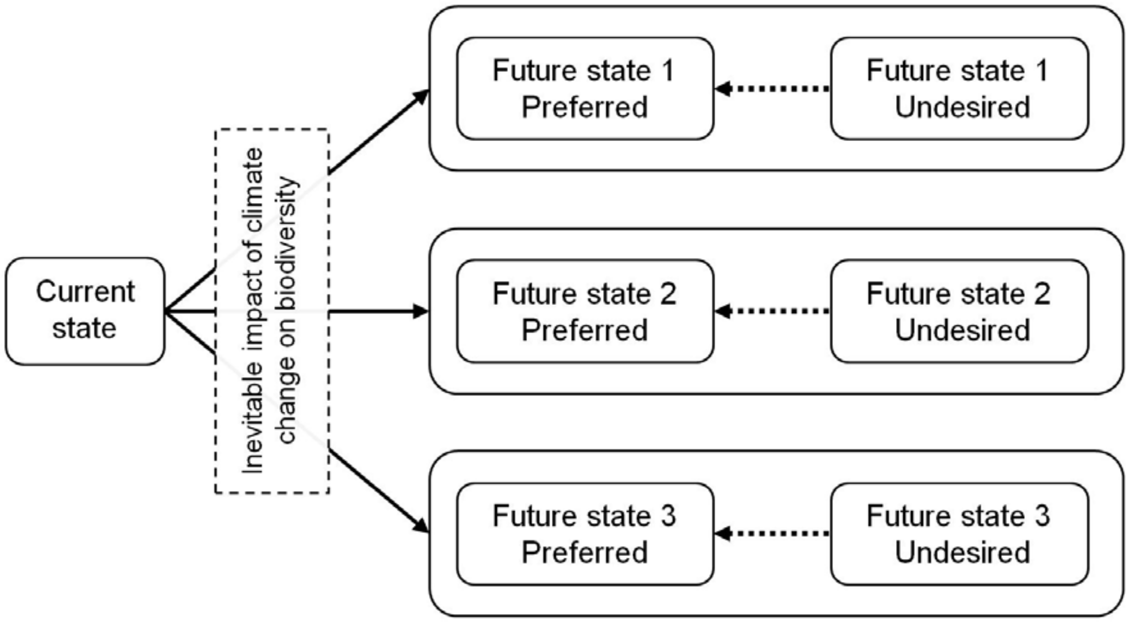

Figure 3: The dynamic conceptualisation of biodiversity conservation with multiple possible trajectories of climate-driven ecological change, and dashed arrows defining the conservation task

This uncertainty has several implications for the design and implementation of conservation strategies. Where the future state is not predictable, the choice and implementation of management strategies may need to be revised formally as the system changes in response to observation, monitoring and research. For example, seeking to maintain specific ecological communities might require species-specific management and periodic updating of the most suitable specific ecological community. However, this 'adaptive management' approach may not be effective where detailed monitoring and regular revision of strategies are not feasible, and where the impacts of management take a long time to establish (e.g. habitat restoration).

An alternative approach to dealing with uncertainty is to develop management strategies that remain effective regardless of the trajectory of ecological change – so-called 'robust strategies'. For example, it is likely that maintaining habitat in a diversity of environments will provide habitat for a large number of species regardless of the degree of turnover of species in individual areas or changes in ecosystem types (Dunlop et al. 2012). Similarly, preventing the destruction of bushland near urban areas will result in people having access to bush regardless of how it changes in response to climate change. Such strategies can then be implemented without detailed monitoring and in preparation for ecological change instead of in response to it.

The robust strategies approach involves articulating desired outcomes for the range of possible future states of biodiversity (if they can be sufficiently defined), or defining those outcomes in terms of ecological attributes that are common to the range of preferred variants of the alternative future states and that clearly distinguish between the preferred variants from the less desired variants. Even then it may be necessary for implementation to include some processes to revise management (e.g. priorities and benchmarks) in response to new information about the nature of environmental change and ecological change.

> *Adaptation proposition 2: Strategies remain relevant and feasible under a range of possible future trajectories of ecological change.*

2.2.3 Multiple dimensions of biodiversity

The conservation of species and communities, particularly threatened species and communities, is a major focus of biodiversity conservation at international, national, state and regional levels, with lists of threatened and endangered entities, supported by legislative frameworks, being used for prioritising conservation investment and restricting some development and management activities (e.g. the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) and state equivalents). Similarly, many recent biodiversity analyses focus on conserving species as they respond in landscapes to climate change (e.g. Shoo et al. 2013; Oliver et al. 2012; Loss *et al.* 2011; Roberts *et al.* 2011; Yamano *et al.* 2011; Minteer & Collins 2010; Walther 2010; Walther *et al.* 2005).

However, it is clear that climate change will affect many attribtues of ecosystems and landscapes, as well as the species in them, that collectively make up biodiversity. This is important for two reasons. First, although these different dimensions of biodiversity are linked ecologically (e.g. species need ecosystems to live in, and ecosystems are made up of species), ecosystems and landscapes are also experienced and valued *in their own right* by the community, in addition to species (Dunlop et al. 2012; Williams et al. 2012a; Millennium Ecosystem Assessment 2005). For example, species are appreciated while bird watching or fishing; ecosystems are enjoyed while picnicking, canoeing or bushwalking; and landscapes are appreciated from a hill-top, headland or aeroplane.

Second, the multiple ecological changes that are likely to take place across the whole country mean that the traditional approach of using threatened species as a proxy for managing other species and biodiversity values (Faith et al. 2004) will no longer be adequate. In a stationary climate, and where threats are reasonably localised, the fates of different dimensions of biodiversity may have been reasonably correlated. For example, the presence of threatened species in an area may have been a reasonable indicator of the presence of a threatening process (habitat loss or invasive species) that may also have affected ecosystem health, other species and other biodiversity values. Management to mitigate the pressure on the threatened species could therefore help ensure a healthy ecosystem for all species within the relevant ecological community. In this approach, conserving threatened species effectively acts as a proxy that enables conservation of a wider range of biodiversity values. However, under climate change, as species, ecosystems and landscapes are affected by multiple ecological change processes, and maybe an order of magnitude more species become threatened, this proxy value of threatened species will potentially be far less useful for conserving other values.

The complement of species at a location, especially of just the threatened species, is therefore a poor characterisation of the way the biodiversity is valued by society, and the fate of the species under climate change is an even poorer surrogate for the fate of biodiversity as a whole at a location. For example, it may be feasible for an ecosystem to change from one type, with a given complement of species, to a different type with a different complement of species, and to remain ecologically healthy. The *type* of ecosystem and *identity* of the species present may be valued by society, but lost; whereas values associated with the presence of a *functioning native ecosystem* and *a diversity of native species* would be maintained.

Therefore, in future conservation strategies, it may be even more important to be explicit about the desired outcomes for the range of different dimensions of biodiversity that are experienced and appreciated by the community. One way of thinking about the dimensions of biodiversity is to consider the separate characteristics of species, ecosystems and landscapes, how they are valued, and how they might be affected by climate change. This process could add value to strategic processes such as framing matters of National Environmental Significance (in the EPBC Act) and Ecological Character Descriptions (under the *Convention on Wetlands of International Importance especially as Waterfowl Habitat*, known as the Ramsar Convention), as well as a wide range of program areas, including invasive species, habitat protection on public and private land, habitat restoration, offsetting and market-based mechanisms, wetlands, coasts and marine.

> *Adaptation proposition 3: Strategies seek to conserve the multiple different dimensions of biodiversity that are experienced and valued by society.*

It is worth noting that there is significant ambiguity about the meaning conveyed in the use of the terms ‘species’ and ‘multiple objectives’ in conservation, as discussed briefly in Box 1 and Box 2.

Box 1: Multiple concepts associated with the term 'species' in conservation

During the course of this research it became apparent that the term 'species' is used to refer to a range of different, although related, concepts. While these multiple concepts are all valid, the presence of the concepts can lead to ambiguity about precise intent, and about means and ends in conservation. Some of the different concepts we identified are:

1. Species, as the well-understood biological unit

Species are often seen as the fundamental unit in ecology. Species are a very important part of how people relate to, experience and value nature; for example, different experiences can result from places with different species. Some people express an ethical position that all species have a right to exist, not just the special one (see below at #2). And some conservation programs are oriented to maximising the number of species that might survive. Managing threatened species can be seen as a logical way of ensuring no species become extinct. Some conservation programs highlight the need to ensure common species do not become threatened.

2. Special species, as focus of particular societal attention

Specific species or groups of species garner greater attention. People choose specific species to have in their backyards, and people visit zoos to see examples of individual species. Some species become iconic through culture or through marketing for conservation, tourism, identity, etc. Threatened species are frequently presented as the epitome of conservation need.

3. Species, as a tool for conservation

Species are very often used as a tool for conservation planning or implementation, for example, spatial prioritisation, use of species-based principles (connectivity), and metrics of biodiversity value (for offsets). Extremely often this uses threatened species; indeed, threatened species are one of the major institutional tools in conservation globally (e.g. IUCN 'red list' and jurisdictional equivalents). Such lists and species are tools in that they are part of the fabric of the institutional process, *in addition to* (often) being valued objects that are protected by the institutional process.

Particular species can be used as a tool for protecting other species (the 'umbrella' concept), or other valued aspects of biodiversity. For example, protecting the habitat of a threatened species will also help maintain ecosystem health and the amount of native ecosystem in a landscape. Threatened species are sometimes used explicitly in conservation campaigns to help prevent damage to other less tangible but possibly much more valued aspects of biodiversity.

4. Species, as a metaphor for nature

Species are the best characterised aspects of nature both scientifically and socially. Hence, species are often used as a metaphor (story line or language) for nature as a whole. A decline in biodiversity is often described in terms of a decline in species. In contrast to the recognisable species concept, precise language is not available to describe the other aspects of biodiversity that people recognise, experience and value (e.g. aspects of ecosystems and landscapes).

Box 2. Multiple Objectives

In recent years there has been growing focus on 'multiple objective' landscape management, sometimes using ecosystem services as a construct to identify a broad range of utilitarian values derived from biodiversity to complement traditional conservation values ('biodiversity for biodiversity's sake'). While identifying these other values may be useful for decision-makers, the conservation-oriented services or values in such approaches often remain narrowly framed in terms of species preservation, ignoring how ecosystem, landscape or other dimensions of biodiversity are directly experienced and valued (e.g. Reyers et al. 2012; Phalan et al. 2011; Polasky et al. 2010; Turner et al. 2007).

Where additional conservation objectives are discussed in the literature, they tend to be in the context of which landscape parameters (such as connectivity, habitat patch size) might be included in a mathematical objective function that is aimed at conserving species (e.g. Monkkonen et al. 2011; Shanahan et al. 2011). In these cases species conservation is the *end* – the objective – and protecting habitat is a technical *means* to that end. Similarly, partly motivated by concerns about climate change and the failure of recent efforts to halt biodiversity declines, there is a trend to broadening the focus of conservation management under banners such an 'ecosystem approach', 'landscape-scale conservation' and 'whole-of-landscape planning' (e.g. *Draft New South Wales Biodiversity Strategy 2010–2015*, *Australia's Biodiversity Conservation Strategy 2010–2030*). However, again these approaches are often based on the reasoning that broader-scale management is required to conserve species, rather than proposing that ecosystems and landscapes per se are experienced and valued by society.

2.2.4 Integrating the propositions: a paradigm shift?

The concepts behind the three propositions are not new to conservation, and many examples of each proposition being considered *to some degree* are apparent in existing conservation documents (Chapters 3 and 4). However, it is clear that these concepts have not been incorporated systematically or to the extent that might be required to adequately address the future impacts of climate change. Together these propositions lead to our 'climate-ready conceptualisation of conservation' (Figure 4). The extent to which this new framing of conservation represents a paradigm shift can be judged by the degree to which the climate-ready conceptualisation of conservation requires not just a broadening of current practice to accommodate the concepts, but a *departure from* the established framing. This is explored in Chapters 3 and 4.

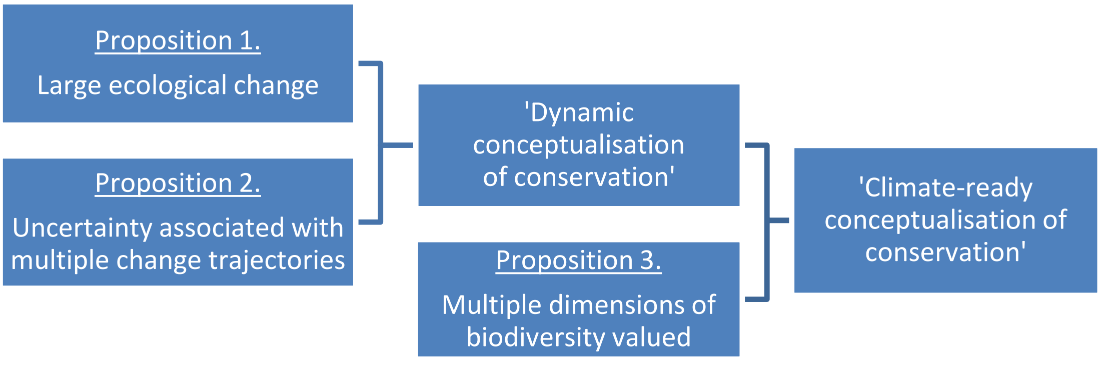

Figure 4: The climate-ready conceptualisation of conservation is the sum of the three adaptation propositions

The one measure of the significance of these propositions can be illustrated by contrasting the attributes typically used to describe biodiversity outcomes in a stationary climate ('static outcomes') with attributes that are more applicable to the 'dynamic outcomes' – those that accommodate both substantial levels of change (proposition 1) and uncertainty in the detail of that change (proposition 2), for a range of different dimensions of biodiversity (proposition 3). While developing these attributes is a significant work in progress, a proof of the concept is presented in Table 2, drawing on previous work on this topic (Dunlop et al. 2012; Williams et al. 2012a; Dunlop & Brown 2008). These outcomes were further developed into prototype climate-ready conservation objectives in Appendix 2.

Table 2: Attributes for describing those aspects of biodiversity that might persist under stationary and changing climates, respectively 'static' and 'dynamic' biodiversity outcomes, for three dimensions of biodiversity that are experienced and valued by society

Dimension of biodiversity *Entities valued by society*	***Attributes of biodiversity persisting under …*** ***stationary climates*** *Static biodiversity outcomes*	 ***changing climates*** *Dynamic biodiversity outcomes*
Individual species (fundamental units of biodiversity, variety of nature)	Abundance, distribution and co-occurrence (community) (also population genetic diversity and demographic structure)	*Existence* of a species (surviving and evolving somewhere)
Ecosystems (functioning unit of ecological-system processes, patch on the ground; quality of nature)	Ecosystem type and condition (composition, structure and function; condition *relative to type*)	Ecosystem *health* (key ecological processes, maintaining and/or cycling water, carbon, nutrients, soil, primary productivity, species diversity)
Landscapes (social–ecological system; many ecosystem services; quantity of nature)	The mixture of particular types of human uses and natural ecosystems	The *balance* of uses (The ration of human and natural domination of ecological process, land water, productivity, etc)

Source: adapted from Dunlop et al. 2012; Williams et al. 2012a; Dunlop & Brown 2008

In a stationary climate, biodiversity outcomes for each of these dimensions (species, ecosystems, landscapes) could reasonably be described in terms of their identity or that of their components, and desired outcomes described in terms of maintaining these attributes (middle column in Table 2). However, all of these attributes would almost inevitably change as climate change progresses. In contrast, the third column includes descriptors of biodiversity that could persist unchanged even in the face of substantial climate-driven ecological change. That is, while the current distribution and abundance of a species might not persist under climate change, the species may continue to exist somewhere else. Similarly, the ecosystem at a given location may change in composition structure and function but remain functioning or healthy. While attributes in both columns are likely to be valued by society, the ones in the third column are in some sense more fundamental as they can persist while the ones in the second column change, but the reverse is not true.

Undoubtedly there are social values associated with the static biodiversity outcomes, and it may be feasible to preserve some of these outcomes, probably with considerable management effort. However, this framework enables consideration of potential climate-ready conservation objectives – articulating which biodiversity outcomes management might seek to preserve (third column) while other attributes change in response to climate change (second column). While many biodiversity programs are aimed at species outcomes, for example, threatened species recovery and investment in threatened ecological communities[3], some programs are arguably oriented towards ecosystem or landscape outcomes (e.g. Great Barrier Reef water quality program[4], cessation of broadscale land clearing[5] and the 'healthy working river' goal for the Murray–Darling system[6]). This framework, in addition to enabling a shift in focus from the static to the dynamic outcomes, enables more explicit consideration to be given to the maintenance of values derived from ecosystems and landscapes. The contrast between the attributes in columns two and three and between the rows highlights just how significantly different climate-ready desired outcomes might be from current ones.

While the specific management activities used to deliver these different outcomes may not be different in type from current activities (e.g. protecting habitat, managing invasive species, restoration, intensive management of individual species), the reason they are applied, the when and where, and the priorities are potentially markedly different, for example, which species to plant in restoration, whether to inhibit or facilitate the establishment of new native species, or even exotic species that provide social and ecological benefit. Discussion of these differences is included in Williams et al. 2012a.

Finally, while substantial and widespread ecological change may be some decades in the future, and there is no end of existing pressures threatening biodiversity today, there is considerable potential for otherwise-sensible investments in the near-term focusing on static outcomes to reduce the opportunities for achieving dynamic outcomes in the future. This is particularly the case in light of growing trends to use metrics of biodiversity value to prioritise investment in some aspects of biodiversity and allow the demise of others, for example, using measures of community type in selecting biodiversity offsets but omitting measures capturing the value to people of native bush close to urban areas. Such processes systematically further weaken the ability of one aspect of biodiversity to be a proxy for other aspects that are valued by society but not included in metrics. Thus delay in clearly articulating desired outcomes that are as effective as possible both now and into the future could readily lead to perverse outcomes in the near term.

2.3 Building these propositions into strategies: climate-ready conservation objectives

2.3.1 How should these three propositions be applied to develop climate-ready conservation strategies?

The majority of the ever-growing literature about adapting the management of biodiversity is narrowly framed, and frequently considers adapting the means of conservation not the end (Hagerman et al. 2010a). In particular, much of the literature focuses exclusively on mechanisms to conserve species (e.g. Shoo et al. 2013; Oliver et al. 2012; Loss et al. 2011; Roberts et al. 2011; Yamano et al. 2011; Minteer & Collins 2010; Walther 2010; Walther et al. 2005). This report argues that the nature of the biodiversity outcomes that are feasible to achieve – the *ends* of conservation management – are fundamentally constrained by climate change. We argue, therefore, that adaptation should include reassessment of the intended outcomes or objectives of

[3] Recovery and conservation plans in Queensland, http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/threatened_plants_and_animals/recovery_conservation_plans.html
[4] Reef water quality protection plan, http://www.reefplan.qld.gov.au/about/rwqpp.shtm
[5] Vegetation management in Queensland, http://www.derm.qld.gov.au/vegetation/index.html
[6] http://www.mdba.gov.au/programs/tlm

biodiversity conservation that are articulated in strategic conservation documents. By objectives we mean *statements of outcomes for biodiversity that are desired by society and that management should be focused on trying to achieve*. These objectives are embodied in multiple stages of the conservation policy, planning and implementation process. Under a climate-ready approach, the critical question becomes: are the biodiversity objectives of a conservation strategy ecologically feasible given the potential impact of climate change? And, if not, how can climate-ready objectives be developed?

Dovers (2005) presents a simple framework for the development of environmental policy involving the elements: 1. Problem-framing, 2. Policy-framing, 3. Policy implementation and 4. Policy monitoring and evaluation, implemented in a continuous adaptive loop. In this framework, much current adaptation analysis is focused on how to adapt implementation (Step 3), rather than considering the potential need to reframe the conservation task. In recognition of this, there have been calls to address the framing, often in terms of recalibrating conservation objectives, but relatively little progress in doing so (e.g. Dunlop et al. 2012; Pittock and Finlayson 2011; Prober and Dunlop 2011; Boer 2010; Hagerman et al. 2010a, 2010b; Heller and Zavaleta 2009; Steffen et al. 2009; Dunlop and Brown 2008).

Using Dovers' (2005) framework as a guide, we present a simple model of a conservation policy/management cycle to articulate how our adaptation propositions might be incorporated into conservation strategies, addressing this issue of framing. In the simplest version of this model (Figure 5) conservation objectives are descriptions of desired biodiversity outcomes; these are used to guide the development and implementation of biodiversity management programs and actions, which in turn have an impact on achieved biodiversity outcomes. Clearly, real-world policy development is much more complex and iterative, with limited opportunities for significant change, and many other factors (e.g. capability constraints or environmental changes) moderating each step and how they feed into each other. While the simplistic model might not describe a chronological sequence of steps in policy development, it represents an idealised flow of influence and a logic structure of concepts. A range of different terms are used to describe objectives in various elements in conservation policy and planning, including visions, goals, objectives, targets, outputs and outcomes. Inconsistency in the use of terms, poorly articulated program logic and the iterative nature of policy development can lead to significant confusion about the actual original intended outcomes from different proposed actions. In this model, the 'Management actions' are the means by which biodiversity outcome ends are met, and the 'Conservation objectives' are statements of the desired ends.

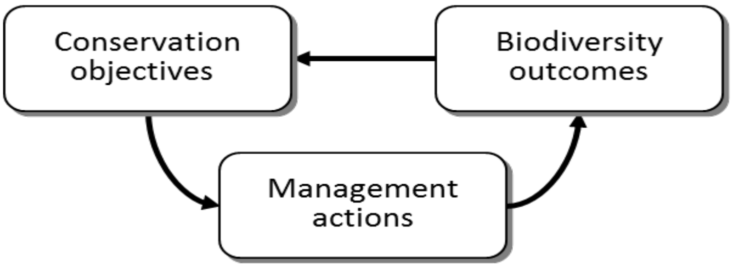

Figure 5: Simple three-step conservation policy cycle with objectives, management actions and outcomes

Objectives are, to an extent, artefacts of complex planning processes rather than actual embodiments of the essence of the strategic intention. In this study we use objectives as a tool to help diagnose the extent to which policy and planning is climate-ready, and to help scope the nature of the task of accommodating the climate change propositions into various decision-making processes with their multiple inputs and constraints. The process of revising policy and planning will be far more complex than simply updating objectives: it is potentially a multi-decade process and will depend on the specific context of different institutions; mapping it is beyond the scope of this study. However, thinking about the need to recalibrate objectives and the factors that make objectives climate-ready will help develop the capacity of decision-makers, stakeholders and researchers to start addressing the issue and laying the foundation for substantial revision when the opportunity arises.

The contrast between the second and third columns in Table 2 demonstrates that, in principle, climate-ready objectives might be substantially different from current objectives. This raises the question of what else contributes to the framing of objectives. Ultimately, policy objectives should reflect social goals, community aspirations and preferences (Straton 2006; Dovers 2005), especially when planning adaptation policy (O'Brien and Wolf 2010; Adger et al. 2005). In our revised policy cycle we identify this framing step as 'Community biodiversity values' (Figure 6). By 'values', we do not mean biodiversity assets (which might be valuable), nor dollar values (market or non-market); we mean preferences and aspirations that are a product of the relationship between people and nature (Brown 1984). Values reflect how people experience and appreciate nature in its multiple dimensions with multiple utilitarian and other reasons for appreciation. Being the product of the *relationship with nature*, values can be expected to change as a result of people's understanding of nature changing, including understanding the inevitability of various changes to species, ecosystems and landscapes.

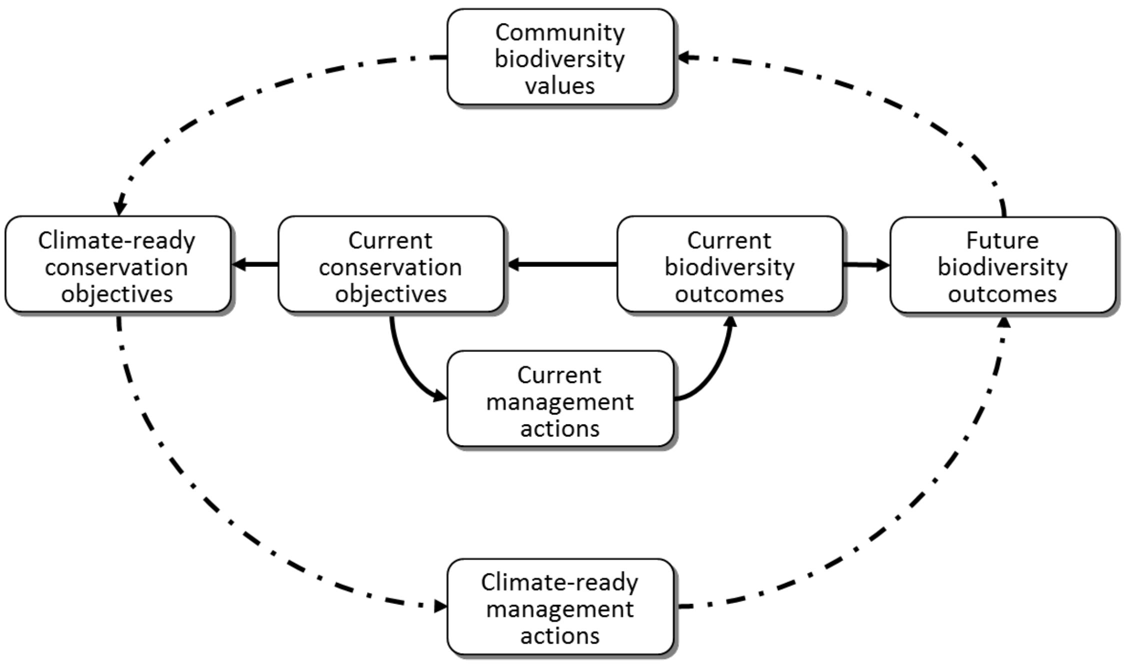

Figure 6: Conservation policy cycle incorporating recalibrated objectives describing feasible desired biodiversity outcomes, leading to updated management and revised outcomes

In this revised model (Figure 6) the 'Community biodiversity values' are critical motivators of conservation; 'Climate-ready conservation objectives' are the product of recalibrating the current conservation outcomes so they reflect biodiversity outcomes that are both technically feasible and socially desirable under future climate change. The 'Climate-ready management actions' are the set of activities needed to implement the new objectives; they are likely to be similar types of actions but possibly implemented in different ways and places for different ends. The 'Future biodiversity outcomes' are the result of new management, evolving threats, climate change impacts and other drivers.

With a focus on conservation objectives, we now formulate the adaptation propositions described above as preliminary criteria for assessing the extent to which objectives for biodiversity conservation may be climate-ready (Table 3). It is important to stress that our intention is that these criteria are applicable to all (forward-looking) objectives that seek to conserve biodiversity in the face of any threats, not just those specifically addressing climate change. In this way, addressing climate change becomes mainstreamed into conservation as a whole (Dunlop et al. 2012). Furthermore, even in the absence of significant climate change, these criteria would also be relevant in the face of other drivers of broadscale ecological change. We anticipate they could form some consideration within a decision-making or planning process but that many other factors would also be important.

Table 3: Preliminary criteria for assessing the climate-ready status of conservation objectives

Adaption criterion
1. The objective accommodates large amounts of ecological change and the likelihood of significant climate change–induced loss in biodiversity.
2. The objective remains relevant and feasible under the range of possible future trajectories of ecological change.
3. The objectives (as a set) seek to conserve the multiple different dimensions of biodiversity that are experienced and valued by society.

Many stated aspirations for biodiversity, particularly in the visions of strategic documents, are broad and non-specific. Depending on how they are translated into objectives and into implementation, they could be interpreted as meeting the adaptation criteria or not. Given the nature of the reframing of conservation being proposed in this report, we suggest that to demonstrate consistency with the reframing, objectives need to be detailed enough to explicitly meet the criteria, not merely be possibly consistent with them. This requires some articulation of the implications of new concepts. Furthermore, to be strictly climate-ready, objectives would need to meet the criteria and be explicitly differentiated from the current 'static' framing of objectives (Section 2.2.4, Table 2).

3. REVIEW OF EXISTING CONSERVATION OBJECTIVES IN AUSTRALIA

This chapter reviews and assesses current strategic biodiversity conservation documents to analyse the extent to which existing conservation objectives accommodate the impacts of significant future climate change using the adaptation criteria described in Chapter 2. The aim was to gauge the state of the conservation decision-making as practised across Australia, not to evaluate and rate individual documents or agencies. The review focused on formally stated objectives, but also examined the intent of documents as articulated or implied in higher and lower level text (e.g. visions and management actions) and general text, to assess the extent to which the implications of significant climate change are understood and incorporated. The chapter includes a description of the document analysis methodology, presentation and discussion of key findings, and discussion of emerging issues.

3.1 Review methodology and document selection

3.1.1 Document selection

Conservation strategies are the focus of, or are embedded within, multiple streams of policymaking and planning at all levels of government within Australia. Unlike most other public policy areas, biodiversity strategies are also developed at the regional scale, primarily through regional NRM bodies (including Catchment Management Authorities, CMAs) found throughout the country. Local government and the Murray–Darling Basin Authority and various NGOs also undertake strategic biodiversity decision-making processes. Australia's biodiversity conservation strategies are also shaped by a series of international agreements and treaties, including most notably the *Convention on Biological Diversity* and the Ramsar Convention. Typically, biodiversity-relevant policies can be found in a variety of types of document that for simplicity we refer to as 'strategic conservation documents':

- Generalised/strategic and/or formal frameworks, plans, policies and legislation that specifically focus on biodiversity protection and management
- Strategies, plans and policies that manage specific elements of biodiversity, e.g. threatened species recovery plans or plans of strategies or plans of management for specific protected areas
- Plans focusing on other, potentially threatening, processes where impact on biodiversity is a consideration, such as bushfire management, management of water supply catchments, operation of water infrastructure, flood mitigation
- Strategies and plans that seek to integrate biodiversity objectives into other land-based activities, most notably farming, water management and urban planning.

Twenty-six strategic conservation documents were chosen, from a preliminary survey of biodiversity documents, for a formal content analysis of conservation objectives and related planning material. The sample of documents was selected to represent a range of jurisdictions and types of strategic document to ensure the review covered a range of geographic, cultural and institutional contexts of strategic biodiversity conservation decision-making in Australia. The documents are listed in Table 4.

Table 4: Strategic conservation documents reviewed and assessed using the climate-ready criteria

Document title	Governance scale	Jurisdiction	Document type
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	International	International	Treaty
World Heritage Convention	International	International	Treaty
Convention on Biological Diversity	International	International	Treaty
Australian Ramsar Management Principles	National	Commonwealth	Policy to implement Treaty
National Framework and Guidance for Describing the Ecological Character of Australian Ramsar Wetlands	National	Commonwealth	Policy to implement Treaty
Environment Protection and Biodiversity Conservation Act 1999	National	Commonwealth	Legislation
Australian Government Biodiversity Policy – Consultation Draft	National	Commonwealth	Policy to implement Treaty
Caring for our Country: Outcomes 2008–2013	National	Commonwealth	Policy Document
Australia's Biodiversity Conservation Strategy 2010–2030	National	Commonwealth	Policy to implement Treaty
Tasmanian Wilderness World Heritage Area Management Plan 1999	State	Tasmania	Policy to implement Treaty
Macquarie Marshes Adaptive Environmental Management Plan	State	NSW	Management Plan
Priorities for Biodiversity Adaptation to Climate Change	State	NSW	Policy
Draft New South Wales Biodiversity Strategy 2010–2015	State	NSW	Policy
NSW Wetlands Policy	State	NSW	Policy
Building Nature's Resilience: A Draft Biodiversity Strategy for Queensland	State	Queensland	Policy/Strategy
Protected Areas for the Future: Cornerstones for Terrestrial Biodiversity Conservation	State	Queensland	Strategy
No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017	State	SA	Strategy
A 100-year Biodiversity Conservation Strategy for Western Australia (Draft). Phase 1: Blueprint to the Bicentenary in 2029	State	WA	Strategy
Murray–Darling Basin Proposed Basin Plan	Regional	Multi-juris.	Strategy
Natural Resource Management Strategy for Southern Tasmania 2010–2015	Regional	Tasmania	Strategy
Central West Catchment Action Plan 2011–2021	Regional	NSW	Management Plan
Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)	Regional	NSW	Management Plan
Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015	Regional	Victoria	Strategy
Climate Change in Goulburn Broken	Regional	Victoria	Planning Guidance
Perth Biodiversity Project	Local Council	WA	Planning Guidance
Tasmanian Land Conservancy Strategy Plan 2011–2015	Non-govt.	Tasmania	Management Plan

Note: citations for these documents are provided in Appendix 1.

3.1.2 Research questions

The following questions were used to help frame the document analysis:

1. What are common themes and concepts used in current biodiversity conservation objectives?
2. Do strategic conservation documents recognise different dimensions of biodiversity (namely species, ecosystems and landscapes), and that different dimensions are valued by the community in multiple ways?
3. Is climate change recognised as a threat to biodiversity? If so, how is this expressed?
4. To what extent do the strategic documents recognise the potential for large-scale change and large-scale loss under a future climate regime?
5. Is it possible to trace a genesis of planning objectives through different scales of the biodiversity governance hierarchy?
6. Are conservation objectives adopting a 'dynamic conceptualisation' of future biodiversity planning tasks, a 'static conceptualisation' or a mixture of both?

3.1.3 Review methodology

Coding or classifying text or imagery using computer software is a standard methodology within the social sciences to abstract and identify themes and organise, analyse and interpret qualitative data that would otherwise be too large or too difficult to use (Cope 2003). The three purposes of coding are to reduce or abstract data in order to generate familiarity, understanding and analysis; create structure in the data; and facilitate analysis. Coding was used for all three purposes in this research. This review followed the analytical techniques set out in Bazeley (2007) and employed NVIVO 10 software (www.qsrinternational.com) to conduct textual analysis of the selected documents. In NVIVO, the user 'codes' by selecting and associating relevant portions of text to one or more labels or 'nodes' that correspond to key concepts of interest within the text. For example, all passages of text expressing a clear desired outcome for biodiversity were coded against the 'outcomes-focused objective' node. NVIVO allows for a nested structure of codes and enables a range of different types of analyses of the coded text.

The theoretical approach set out in Chapter 2 of this report was used to develop an initial coding structure within NVIVO based on the climate-ready assessment criteria. These were then iteratively revised as the review and coding progressed and new issues arose. Additional nodes within the coding structure were developed and used to capture interesting complementary information (e.g. discussions of adaptive management, resilience and community values) as well as to help identify implicit values and objectives that could be inferred from the management activities. These values and objectives were included to test the assumption that while documents may recognise and plan for climate change in their overall objectives, analysis of activities may reveal these are not actually translated effectively in management, indicating where climate change is not having a material impact on biodiversity planning.

Table 5: Summary of coding nodes used in NVIVO

What is the policy objective of the document?
To prevent loss of biodiversity or restore it to earlier condition/state?
To reduce loss of biodiversity going into the future?
Are the objectives focused on achieving an outcome?
Are the objectives focused on achieving the delivery of a process or input into biodiversity management?
Static versus dynamic conceptualisation of objectives
Does the objective (explicitly) assume a dynamic future climate?
Does the objective (explicitly or implicitly) assume a static/stable future climate?
Is it unclear whether the objective assumes a static or dynamic future climate?
Does the document use a resilience-type framework for planning and management?
What is the focus of the document? Is to protect/manage:
Biodiversity in general?
Species?
Ecosystems?
Landscapes?
Biodiversity that is threatened?
Biodiversity that is iconic?
Or does the document include non-biodiversity-related objectives?
What attributes of biodiversity are being planned for/managed?
A diversity (variety) of biodiversity elements?
The quality of the biodiversity? (e.g. Strong ecological processes?)
The quantity of biodiversity being protected?
What is the biophysical scale at which the management is carried out?
At an ecosystem scale?
At a landscape scale?
At a species scale?
Does the document recognise change in biodiversity?
Due to non–climate change drivers?
Due to climate change?
Does it recognise the magnitude of potential change under future climates?
Does it recognise the uncertainty of potential change under future climates?
What kinds of on-ground actions are being planned?
Awareness raising/capacity building
Corridors construction
Do nothing
Institutional reform
Managing threatening processes
Mutually beneficial economic activity
On-ground physical works
Partnerships
Protection and conservation
Research and monitoring activities
Restore, rehabilitate, re-populate

NVIVO's key strength as an analytical tool is to identify and record relationships between ideas and between research objects (e.g. documents, people). This was exploited in this study through the tactic of 'double coding' broad sections of text, that is, coding a complete statement or set of ideas at more than one node. Initial coding nodes were kept expansive and general in their descriptions, and then annotations, 'coding on' (coding text at one node onto another node), active links and memos were used to provide reference to related documents or ideas. A summary of the key parts of the coding structure is set out in Table 5.

A set of heuristics was developed for assessing whether a plan was adopting 'static' or 'dynamic' (climate-ready) conceptualisations of different dimensions of biodiversity outlined in Chapter 2 (Table 6).

Table 6: Descriptions of typical static and dynamic management objectives to guide coding

Dimensions of Biodiversity	STATIC An objective was considered to have a 'static' conceptualisation if it sought to maintain:	DYNAMIC An objective was considered to have a 'dynamic' conceptualisation if it sought to maintain or accommodate:
Individual genes/species VARIETY of biodiversity	• current location, abundance and genetic structure of populations • specific ecological communities in their current locations • the composition and structure of existing ecological communities either in the same locations (i.e. same spatial distribution) or elsewhere but with similar area (i.e. different spatial distribution but essentially the same abundance and type)	• change in population locations abundance or genetic variety • changes in composition and location of communities • the diversity of ecological communities – but not specific communities in specific locations
Ecological Communities/ Ecosystems QUALITY of ecosystem and ecosystem processes (functional units of biodiversity)	• the current type of ecosystem at each location • the condition of ecosystems relative to the 'reference condition' of the current ecosystem at each location	• the condition of the ecosystem in a particular place relative to expected futures under climate change • the function, processes or health of the ecosystem in a particular place (in whatever form it takes under future climate change scenarios)
Landscapes Quantity of biodiversity experiences through 'amount' of nature and mixture of landscape uses and ecosystems	• the type and extent of natural ecosystems and human uses in the landscape	• the proportion or intensity of human use of resource in the landscapes, while accommodating change in the type of activities and ecosystems • the area of native habitat or the naturalness of river/wetland flow regimes

The 'matrix' search function of NVIVO was used to develop concept-driven summaries and identify key relationships between concepts within the texts. These summaries were used as the basis of the results section.

3.2 Important note about this review

The review and assessment in this project were conducted to assess the extent to which conservation in Australia is already prepared for the consequences of future high levels of climate change, with a view to scoping the issues involved with adapting conservation decision-making, in the future, to address climate change. The assessment was not conducted to rate individual strategic documents; individual documents are used to sample the body of conservation practice in Australia, and excerpts from individual documents are used to illustrate points, not highlight individual strategies. Similarly, in no way did this project assess the current effectiveness or suitability of current conservation objectives or strategies.

3.3 Key findings

3.3.1 There was little consistency across documents in how objectives were defined, developed or expressed

There was significant variation in how the biodiversity objectives were articulated, the language used and the concepts employed. A prior expectation of this research was that management objectives for biodiversity conservation would be clearly articulated as explicit outcomes with respect to the desired state, properties or condition of species or ecosystems, with clear lines of direction from higher-level objectives to lower-level ones, with the latter expressing how the objectives would be achieved. In the majority of documents sampled, conservation objectives were not set out in terms of clear biodiversity outcomes. Most did have clear objectives, but they were often focused on issues (such as threats) or inputs (protecting habitat), rather than biodiversity outcomes that might be achieved. Many objectives were also too open to interpretation for a clear reading of the extent to which they were climate-ready. Even where outcome-oriented objectives were included, they were frequently so broad or conceptually vague that it was not evident how they might provide clear guidance to the implementation of management actions so they could achieve specific outcomes. It was sometimes possible to infer objectives from higher-level text or by the way management actions that were described.

A wide range of language, concepts and structures were used to describe what each strategy sought to achieve (see Box 3 for details). To a certain extent this was not surprising and reflects the institutional contexts of the different documents. However, it did make it difficult to compare and contrast concepts and approaches and consistently assess whether objectives were climate-ready or not.

Box 3: Current concepts in biodiversity objective setting

There is significant heterogeneity in the frameworks, language and structure across the 26 documents surveyed in this study. Despite this, patterns of common concepts and themes emerged from the data to provide an overall picture of biodiversity objectives used across Australia. Below is a selection of biodiversity objectives used in the reviewed documents.

Objectives across all different dimensions of biodiversity were represented, with the key themes being managing threats; building resilience; building connectivity; restoring and protecting species, habitats and ecological processes; and managing at the landscape scale. It is notable that for landscape-scale management, the objectives suggest that landscape management is for the protection of something else (species, ecosystems) rather than management of landscapes for their own sake.

Objectives relating to species

Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening.

Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)

Invest in research to find a solution to the Tasmanian Devil facial tumour disease and assist in establishing a disease-free Devil population.

Caring for our Country: Outcomes 2008–2013

Focus on protecting the habitats and communities of nationally threatened and endangered species and endangered ecological communities (including through engaging private landholders and expanding the National Reserve System).

Caring for our Country: Outcomes 2008–2013

T10 recovery/action plans are implemented for:
1. 40% of South Australia's Endangered and Vulnerable (terrestrial vertebrates and vascular plants) threatened species
2. 6 South Australian nationally threatened ecological communities, by 2012

No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017

By 2021, increase the number of management interventions coordinated to improve habitat of native flora and fauna including threatened species to achieve stable state

Central West Catchment Action Plan 2011–2021

Objectives relating to ecosystems

2.1.1 An increase in the number, extent and condition of ecosystems protected under secure conservation tenure

Australian Biodiversity Conservation Strategy, 2010–2030

Target 5: By 2015, 1,000 km^2 of fragmented landscapes and aquatic systems are being restored to improve ecological connectivity.

Australian Biodiversity Conservation Strategy, 2010–2030

(a) to protect and restore water-dependent ecosystems of the Murray–Darling Basin; and
(b) to protect and restore the ecosystem functions of water dependent ecosystems; and
(c) to ensure that water-dependent ecosystems are resilient to risks and threats;

Murray–Darling Basin Plan

Principle 1. Retention of at least 30% of the pre-European extent of each ecological community is required to prevent an exponential loss of species and failure of ecosystem processes.

Perth Biodiversity Project

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2. Native ecosystems retain as much of their natural function as possible, and where this is diminished, are able to recover to the extent that they meet species persistence and human needs goals.

Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015

Objectives relating to landscapes

We need to ensure that species have large areas of linked habitat, in many different environments across all landscapes, along the coasts and in the oceans. Achieving landscape scale change will require working with the public and private sectors across a range of tenures.

Australian Biodiversity Conservation Strategy, 2010–2030

Key Strategic Direction 8: Conserve landscapes/seascapes for biodiversity (integrating on and off-reserve conservation and managing system-wide threats)

A 100-year Biodiversity Conservation Strategy for Western Australia (Draft). Phrase 1: Blueprint to the Bicentenary in 2029

Goal 2: Healthy, resilient, sustainable and ecologically functional landscapes and seascapes supporting vibrant communities and viable natural resource–based industries.

Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)

Despite the variety of ways that biodiversity conservation objectives are articulated, several broad trends were evident. First, in many documents where biodiversity outcomes were not clearly expressed in the objectives, desired outcomes could be inferred, to some extent, from the supporting text or from lower-level actions and targets. In many instances, the document itself did not contain the sufficient level of detail to get a full understanding of intentions and these were left to subsidiary management-activity planning documents or technical documents. For example, a stated objective may focus on restoring habitat with priority locations determined by a spatial analysis, but the ‘objective function’ of that analysis – the embodied desired outcome – is not explicit nor linked to the objectives in the document being examined.

Second, many objectives are ‘process’ or ‘action’ focused rather than expressing a desired policy outcome for biodiversity. In some cases, this leads to a confusion between means and ends of the planning process, and suggests that planners are focusing more on the *how* of biodiversity conservation rather than *what* is to be achieved. This played out in various ways. Some objectives focused on things management could directly achieve (e.g. fencing or weed control) – essentially the ‘outputs’ of management, rather than the ‘outcomes’ or desired change in the state of biodiversity under management. Alternatively, some strategic documents expressed the need to work towards the establishment of a particular policy process or institutional structure for the purpose of improving biodiversity conservation outcomes, for example, the development of market-based instruments to create incentives for biodiversity conservation on private land, or the use of the best scientific knowledge.

Third, in some documents there was an objective to adopt ‘strategic processes’, such as investment prioritisation processes or collaborations with partnership organisations to work across landscapes and tenures.

Fourth, another emergent trend was for strategic documents to include objectives about non-biodiversity-related outcomes, with biodiversity management as the tool by which some broader objective was to be achieved. For example, *Australia’s Biodiversity Conservation Strategy 2010–2030* has a sub-objective of increasing employment and participation of Indigenous people in biodiversity conservation activities. Increasingly, biodiversity strategies also have sequestration of atmospheric carbon dioxide as an objective.

3.3.2 There was widespread recognition of climate change impacts on biodiversity in the high-level text of most strategic documents

There is a very high degree of recognition within the reviewed documents that climate change will have an adverse impact on biodiversity. It was broadly recognised that climate change would have impacts on biodiversity directly (e.g. through increasing temperatures), through changed disturbance regimes (fire and flood), and by increasing the impact of other threatening processes (habitat loss). For example:

> Climate change is increasing the rate at which we are losing biodiversity by amplifying existing pressures and introducing new challenges.
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

> The major threats to biodiversity in Queensland result from past and present reduction in the extent of habitat and impacts on habitat condition through fragmentation and degradation. Climate change will compound and increase the severity of current threats and create new pressures on many ecosystems.
>
> *Building Nature's Resilience: A Draft Biodiversity Strategy for Queensland*

3.3.3 Most reviewed documents recognised the need for, and aimed to, prevent loss in biodiversity but there was significantly less recognition of (large scale) climate-induced change or loss in biodiversity

In general, the magnitude and pervasive nature of the future ecological impacts of anticipated climate change (e.g. significant loss of species and changes in ecological types) and the systemic implications for conservation strategies were not well recognised. The majority of strategic documents implicitly equated ecological change with loss of values, and they aimed to prevent such loss, frequently including objectives to restore the status of species or condition of ecosystem to some ideal state. While it was sometimes recognised that a pre-European state or extent is infeasible, there was very little acknowledgement that climate change could lead to widespread extinctions and substantial changes in ecosystems and landscapes. For example:

> It is essential that actions aim to maintain and improve existing plant and faunal communities, *preventing* an increase in the number of species being listed as threatened or declining. [emphasis added]
>
> *Central West Catchment Action Plan 2011–2021*

> Engage with landholders and land managers to *maintain or improve* the *security* of threatened species [emphasis added]
>
> *Management Strategy for Southern Tasmania 2010–2015 (NRM South)*

Some documents went further and included targets for the number of threatened species that would be recovered, for example:

> *Improvement* in the conservation status of at least 100 threatened species through recovery action, including 20 species *fully recovered* and removed from the State's threatened species [emphasis added]
>
> *A 100-year Biodiversity Conservation Strategy for Western Australia (Draft). Phrase 1: Blueprint to the Bicentenary in 2029*

There was little or no acknowledgement that those target numbers might be a small fraction of the number of possible species imperilled due to climate change. Similarly, many documents included targets for conserving areas or proportions of ecological communities with no recognition that these communities could well change to different or novel types. For example:

> Principle 1. Retention of at least 30% of the pre-European extent of each ecological community is required to prevent an exponential loss of species and failure of ecosystem processes
>
> *Perth Biodiversity Project*

Overall, climate change was often presented as 'yet another' threatening process alongside other existing threats that could be ameliorated with the appropriate management framework, as opposed to a systemic, large-scale issue acting on all species and ecosystems and affecting the achievability of current conservation objectives. For example:

> Climate change is considered by Auld and Keith (2009) to be one of the five major threats to biodiversity, the others being destruction and fragmentation of habitat, changes in disturbance regimes, threats reducing functionality of biological interactions or life cycle processes, and over-exploitation of native species. Climate change may also exacerbate several existing threats to biodiversity.
>
> *Priorities for Biodiversity Adaptation to Climate Change (NSW State Document)*

The general implicit approach was that the climate change threat could be managed with specific strategies such as the use of adaptive management or a resilience framework, or actions such wildlife corridors, translocations or enhanced bushfire management. The strong implicit impression was that these actions could nullify the threat of ecological loss or even enable ecosystems to resist the pressures of climate change and retain or improve condition and extent:

> Create and manage macro-scale ecological linkages in the south-west of the State to ameliorate or accommodate the effects of climate change on biodiversity, and to build ecosystem resilience and connectivity of the formal conservation reserve system and off-reserve initiatives that focus on managing high biodiversity values and contribute to restoring ecological connectivity and landscape reconstruction.
>
> *A 100-year Biodiversity Conservation Strategy for Western Australia (Draft). Phrase 1: Blueprint to the Bicentenary in 2029*

> *Outcomes for reducing threats to biodiversity*
>
> 2.3.1 A reduction in the impacts of priority threatening processes, including habitat loss and climate change
>
> …
>
> 2.3.3 An increase in the use of strategic and early interventions to manage threats to biodiversity including climate change
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

> There will also be a focus on understanding the resilience of ecosystems to climate change and identifying opportunities to support ecosystem adaptation. Adaptation will be the main focus of natural resource management activity in the climate change area
>
> *Natural Resource Management Strategy for Southern Tasmania 2010–2015*

3.3.4 There was little recognition of the systemic level of uncertainty associated with the impact of climate change on biodiversity

Although change was broadly recognised as a concept, most documents did not recognise any level of uncertainty associated with the detail of that change. Two exceptions to this trend were the *Macquarie Marshes Adaptive Environmental Management Plan* and the *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*. However, in both of these cases, uncertainty, and the need to manage uncertainty, was associated with the drivers of change to biodiversity, rather than uncertainty surrounding how biodiversity may respond to future climate scenarios. Under a truly climate-ready approach, both types of uncertainty would ideally be acknowledged and planned for. For example:

> Four scenarios of water availability and area of wetland that can be sustained are outlined. While considerable uncertainty exists under each scenario – particularly in relation to the volume of unregulated flow that may benefit the marshes – the scenarios provide context for water planning, environmental water recovery and environmental water management.
>
> *Macquarie Marshes Adaptive Environmental Management Plan: Synthesis of Information Project and Actions*

> CAP2 provides the overarching strategic direction for … building the adaptive capacity of our communities and natural resources to cope with change, shocks and uncertainty
>
> Drivers are complex in their origins; they interact, and are in a constant state of near-unpredictable change. They operate differently and to varying degrees across our Socio-ecological Landscapes and create different issues across the Region. Embracing a new systems-based approach grounded in a resilience framework allows us to deal with and manage for this uncertainty.
>
> *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*

3.3.5 There was a large focus on species, especially threatened and iconic species. However, there was also widespread recognition that other dimensions of biodiversity are also important

The majority of strategic documents used some form of threatened species or species focus as a central component of biodiversity conservation. Language about species, or related to species-type concepts (e.g. habitat or communities) remains the pervasive language of biodiversity planning in that it is used to ultimately describe, and therefore conceptualise, why conservation is important. For example, of the six areas of legislative powers provided to the Commonwealth under the EPBC Act, three of them are directly related to species conservation (Wetlands, Threatened Species and Migratory Species). Similarly, the *Australian Government Biodiversity Policy – Consultation Draft* describes losses in biodiversity primarily in terms of species loss:

> Biodiversity decline includes the reduction in extent and condition of habitat, a drop in the number and ranges of species in particular regions, a loss of genetic diversity within species, and a loss of abundance of animals … The number of species becoming threatened continues to increase, and many common plants and animals have lost genetic diversity through reduced population sizes and localised extinctions. The decline of biodiversity is most obvious in the decreasing populations of vertebrate animals, loss of extent of habitat, and the fragmentation and degradation of forests, rivers and other ecosystems.
>
> *Australian Government Biodiversity Policy – Consultation Draft*

Within this context, species are managed and protected either for their own sake or because they are proxies for the health of biodiversity more generally:

> Objective 4: Use a cost-effective approach to prioritise threatened species for recovery. This draft Strategy proposes to improve the way we invest in our threatened species. The aim of this work is to maximise the number of species recovered for the funds available and, in doing so, deliver efficient and effective recovery of threatened species
>
> *Draft New South Wales Biodiversity Strategy 2010–2015*

> 2. Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included.
>
> *Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)*

Despite this, there was widespread, although not universal, recognition of different dimensions of biodiversity and the different ways these are valued across the community. For example:

> Goal 2: Healthy, resilient, sustainable and ecologically functional landscapes and seascapes supporting vibrant communities and viable natural resource–based industries
>
> *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*

> Goal I – Conservation of South Australia's biodiversity
> South Australia's landscapes and seascapes, including natural and modified ecosystems and communities within and outside of protected areas, rural production and urban environments, and the ecosystems and native species within these areas
>
> *No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*

The specific nature in which different dimensions of biodiversity were recognised was dependent on the nature of the document and the context of the planning processes. For example, some documents identified different dimensions as part of a nested hierarchy (e.g. *Australia's Biodiversity Conservation Strategy 2010–2030*) while the plan for Tasmania's World Heritage Area, by its very nature, was focused on landscape-scale conservation:

> The area covered by this plan includes most of the Tasmanian Wilderness WHA … It also includes 21 adjacent areas of National Park and State Reserve ... which are outside the Tasmanian Wilderness WHA but are covered by this management plan... total area (approximately 20% of land area in Tasmania) of 1.4 million hectares.
>
> *Tasmanian Wilderness World Heritage Area Management Plan 1999*

It was also commonly observed that strategic documents conflated different dimensions of biodiversity and used the all-encompassing terms such as 'biodiversity values' or 'assets' with little clarity of what dimensions were being valued.

> Ensure that land use planning and development (local and regional level) incorporates consideration of natural resource considerations and seeks to take reasonable steps to minimise the adverse impacts of development on the Region's natural resource assets.
>
> *Natural Resource Management Strategy for Southern Tasmania 2010–2015*

> Assess the management of areas within the National Reserve System against consistent standards, and ensure management actions are focused on protecting biodiversity values and improving resilience in the face of climate change and other pressures.
>
> *Caring for our Country: Outcomes 2008–2013*

3.3.6 In many situations, while an objective may have been focused on one dimension of biodiversity, the management may have been targeted at a different scale

In Chapter 2 it was argued that the climate-ready criteria should be applied to the desired biodiversity outcomes (the 'ends'), which requires the description of objectives to clearly differentiate between the management means (how it is achieved) and conservation ends (what is to be achieved). In a substantial number of strategic documents, ends and means were conflated and management of one dimension of biodiversity was used as a mechanism for conserving values associated with another dimension. For example, in many documents the connectivity at landscape scales was used as a means to maintain the survival of species populations, as opposed to providing outcomes associated with landscapes per se. Similarly, ecosystem-scale management was prescribed to achieve species conservation in some documents:

> All investment and actions in native vegetation will be in areas that present opportunities to improve vegetation connectivity and cover, as shown in the priority maps for each Catchment landscape. *Improving connectivity at a local and landscape scale* and increasing cover above 30% or maintaining above 70% is *known to assist in improving species biodiversity and sustaining species populations* [emphasis added]
>
> *Central West Catchment Action Plan 2011–2021*

> Healthy ecosystems supporting viable populations of native flora and fauna.
>
> *Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015*

Managing one dimension of biodiversity for another can clearly be ecologically sound, if not best practice, and it is certainly not a 'scale mismatch'. However, it does lend itself to lack of clarity about means and ends, making it unclear if the intentions of a strategy meet the climate-ready criteria. For example, if landscape management is stated to be for the purposes of enabling species protection, then (that part of) the strategy is not explicitly recognising and seeking to protect landscapes for their own values but is using landscapes as a tool (means). Protection of some landscape values may still occur, but is likely to be incidental and may not be the intention of the strategic document's author.

In many strategies, the scale or dimension of management matched that of the values being protected, but the specific object of conservation varied from the management target. For example, many documents included the management of an invasive species, not because the invasive species was valued, but for the purpose of maintaining populations of native species. While managing invasive species is at the same scale as managing native species, this approach can also lead to lack of clarity about means and ends.

3.3.7 There was clear hierarchical linking between many management strategies, for example, from international, through to national and regional strategies

In most of the strategic documents reviewed there was a clear institutional hierarchy between strategies formulated at higher scales of biodiversity governance through to those that are more focused on implementation or planning at management scales. In many instances, this hierarchy was explicit and it was possible to draw a direct lineage from an international treaty, through national and state strategic documents to regional plans (e.g. Box 4). This lineage was reflected most strongly in commonality of key concepts and language. Frequently, however, the scope of the strategy varies down the lineage as institutional mandates and agency roles varied, so the spatial hierarchy of strategies may reflect a hierarchy of institutional control.

Some documents were written in a way that explicitly demonstrated their contribution to the objectives of higher documents, with the links reflected in both the language and in the nature of the objectives. In some instances, higher-level documents provided clear frameworks or guidance about objective setting for lower-level documents, but typically this required close jurisdictional linkage. For example, NSW Catchment Management Plans are explicitly required to demonstrate how their plans contribute to broader state NRM targets.

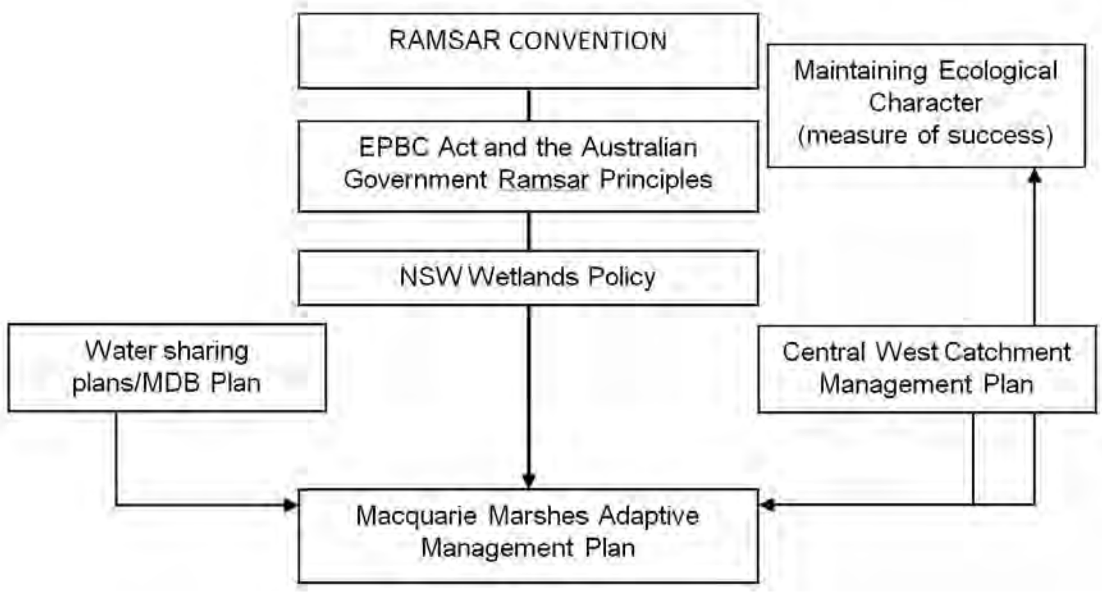
Box 4: Institutional hierarchy in the management of the Macquarie Marshes

A good example of institutional nesting can be found in the approach of managing Australia's international significant wetlands under the Ramsar Convention.

The Ramsar Convention was negotiated in the 1970s for the explicit purpose of promoting the wise use of and conserving wetlands, in recognition of the role wetlands have in the conservation of migratory bird species and the dependence of many people on wetlands. Cobourg Peninsula in the Northern Territory was the world's first Wetland of International Importance designated under the convention in 1974.

Under its external affairs powers in the Constitution, the Australian Government has primary responsibility for implementing treaty obligations, but constitutionally the state governments retain power over regulation of natural resources, including wetlands. This means the chain of responsibility for managing wetlands passes through the Australian Government to the states and in many cases through to regional NRM agencies as well.

This hierarchy of management and influence can be clearly seen in the institutional arrangements established for the management of the Ramsar-listed Macquarie Marshes, and in the common language of maintaining ecological character throughout the chain of strategic documents. An institutional map for reflecting *why* the Marshes are actively managed (because they are listed under the Ramsar convention), *what* they are managed for (to maintain ecological character), and *who* gets a say in management (Australian and NSW governments, MDBA, CWCMA) is set out below.



3.3.8 Objectives and management action in many strategic documents focused on social and economic processes to facilitate conservation outcomes in the long term and capacity building within agencies and among managers

Rather than specifying desired ecological outcomes, a number of documents included objectives for the development of social or economic processes to underpin effective investment in and implementation of biodiversity conservation actions. For example:

> Goal: Community ownership and stewardship for biodiversity – informed, motivated, empowered and engaged urban, rural and Indigenous communities, governments and industries that better value and share the responsibility for, and enjoy the benefits of, South Australia's terrestrial, aquatic and marine biodiversity
> Desired outcomes by 2010–2030:
> South Australians:
> - better understanding species, habitats and ecosystems
> - recognising the intrinsic and instrumental values of biodiversity
> - embracing the vision for conserving, sustainably using and living with biodiversity
> - taking responsibility for the conservation and sustainable use of biodiversity
>
> Government, industry and community having a clear understanding of each other's roles and responsibilities for biodiversity conservation and management.
>
> *No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*

> Outcomes for enhancing strategic investments and partnerships
> 1.3.1 An increase in the use of markets and other incentives for managing biodiversity and ecosystem services
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

Many documents also included objectives and management actions aimed at increasing the capacity of managers and agencies. These included institutional reform, research, monitoring and partnerships. Most of the documents analysed reported at least one objective or action that involved some type of institutional reform:

> Review and modify the Master Plan for Queensland's Protected Area System to establish a long-term vision for Queensland Parks and Wildlife Service, supported by a strategic plan that achieves key targets for protected area and wildlife management.
>
> *Building Nature's Resilience: A Draft Biodiversity Strategy for Queensland*

> Outcomes for delivering conservation initiatives efficiently
> 3.2.1 An improvement in the alignment of sectoral, regional and jurisdictional biodiversity conservation approaches with Australia's Biodiversity Conservation Strategy
>
> Outcomes for implementing robust national monitoring, reporting and evaluation
> 3.3.1 An increased representation of biodiversity and ecosystem services and goods within national accounts
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

Almost all the documents incorporated actions that included capacity building:

> Enhancing community capacity to undertake NRM activity: Define a base level of community capacity required for the Region, and develop and implement a maintenance program to sustain this level.
>
> *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*

> Invest in actions, in partnership with state, territory and local governments, that support the community's ability to apply this information.
>
> *Caring for our Country: Outcomes 2008–2013*

3.3.9 *Many strategic documents included objectives focusing on social outcomes that might result from the process of biodiversity management*

Biodiversity conservation, particularly at the regional scale, was often seen in a broader socio-economic context. While biodiversity was clearly valued in its own right, objectives in various reviewed documents sought to use investment in the management of biodiversity to also deliver broader social outcomes. The key example was the use of biodiversity conservation to generate employment opportunities for Indigenous people, income from tourism or sequestration of carbon dioxide. For example:

> CGC1: Natural resource management decisions contribute to improving or maintaining social and economic wellbeing, including increasing adaptive capacity
>
> C1: By 2021, increase the number of NRM projects that provide opportunities for social and economic wellbeing
>
> *Central West Catchment Action Plan 2011–2021*

> Priority for Action 1.2 Increasing Indigenous engagement
>
> Indigenous peoples play a significant role in biodiversity conservation in Australia. Increasing engagement through employment, partnership and participation and through the two-way transfer of knowledge will not only lead to improved opportunities for Indigenous peoples but also to improved outcomes for biodiversity.
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

Other examples include appreciation and respect for cultural heritage and Indigenous heritage (*Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP 2)* in NSW, *Tasmanian Wilderness World Heritage Area Management Plan 1999*), and facilitating economic development (*Natural Resource Management Strategy for Southern Tasmania 2010–2015*).

3.3.10 *There was some recognition of the climate-ready concepts, including limited examples of climate-ready approaches, but they were not widespread and sometimes not explicit in objectives*

As noted above, many strategic documents included language that gave some reference to the concepts at the core of the climate-ready conceptualisation presented in Chapter 2. However, in the vast majority of cases the concepts were not currently developed or implemented to the extent that might be required to effectively manage biodiversity under climate change, and it was clear that 'static' aspirations or assumption were still embedded in the documents.

For example, many documents acknowledge variability in the state of an ecological system, and recognised some probability of loss, but failed to recognise that the system might be driven by climate change along a trajectory of substantial change to new states. Furthermore, where there was some recognition of the climate-ready propositions, these ideas were not necessarily reflected in the actual biodiversity objectives where static type language is used to describe intended outcomes. For example, the South Australian Biodiversity Policy, *No Species Loss,* incorporates responses to climate change, as well as setting in place objectives for conservation more broadly. In describing the potential impacts of climate change on biodiversity, this document readily incorporates many climate-ready ideas:

> **Understanding impacts will require a significant and coordinated research effort.**
> How South Australia's species and ecosystems respond to these climatic changes is uncertain. Species might change in distribution and abundance, population dynamics, life history patterns and reproductive cycles; vulnerable species might be at increased risk of extinction; invasive and over-abundant native species might gain more opportunities for establishing in wider areas. Ecological processes could well change. The uncertainty associated with these changes

> demands that research initiatives and practical solutions to the impacts of climate change be flexible, adaptable and innovative if they are to deal with the vagaries of South Australia's uncertain climate future.
>
> *No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*

However, this recognition of uncertainty and change is not reflected in the language or conceptualisation of the stated outcomes (objectives) identified for biodiversity conservation more broadly. Rather, these objectives adopted static language aimed at preventing change or maintaining the status quo:

> **Goal I – Conservation of South Australia's biodiversity**
> Conservation of South Australia's biodiversity–conservation of South Australia's terrestrial, aquatic and marine genes, species, and ecosystems and their ecological processes, within healthy and sustainable natural, production, urban and public landscapes
> *Desired outcomes by 2010–2030*
>
> - Species, ecosystems, and landscapes and seascapes *maintained, improved and restored* over long timeframes [emphasis added]
> - A net gain in extent and condition of biodiversity where:
>   - priority degraded habitats are restored, increased in area, improved in ecological condition and better connected
>   - ecological connectivity is maintained or restored across some important landscapes and seascapes
>   - a comprehensive, adequate and representative range of habitats and ecosystems are protected and adequately managed on public and private lands
>   - habitat is not further degraded and no *further extinctions are human induced*
>   - genetic diversity is maintained, and in situ conservation of native genetic resources is complemented by ex situ means, where required
>   - no new threats are introduced and existing threats are mitigated effectively
>   - overabundant or impact-causing native species in conflict are managed in a way that mitigates impacts and conflict, encourages the development of strategies to live with wildlife, and ensures species conservation
>
> *No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*

Many strategic documents were potentially consistent with the climate-ready conceptualisation, but they were not necessarily conceived as such or presented in that way. For example, the comprehensiveness and representativeness framework of the National Reserve System essentially delivers conservation outcomes that meet the climate-ready criteria, but the language used to describe and implement it includes reference to protecting current ecosystem types, which is not climate-ready, whereas reference to maintaining the diversity of ecosystems through time or the diversity of environment types would be consistent with the criteria:

> A well managed, comprehensive, adequate and representative National Reserve System has been established to protect in perpetuity examples of at least 80 per cent of the extant native ecosystems present in Australia.
>
> *Caring for our Country: Outcomes 2008–2013*

Similarly, the Tasmanian Wilderness World Heritage Area strategic document incorporated objectives that are very consistent with many of the features of the climate-ready criteria; however, in the description there is no attempt to separate static and dynamic aspects to values to be conserved:

> 4. To conserve the values of the WHA in a manner consistent with their natural and cultural significance, and where appropriate, feasible and sustainable, to rehabilitate or restore degraded values. In particular to:
>
> 4.1 maintain or restore natural diversity and processes;
> 4.2 maintain or enhance wilderness quality;
> 4.3 maintain or enhance environmental quality;
> 4.4 maintain or enhance landscape quality and
> 4.5 protect and conserve historic heritage and Aboriginal heritage (in partnership with the Aboriginal community).
>
> *Tasmanian Wilderness World Heritage Area Management Plan 1999*

There were several notable exceptions to the above trends, with evidence that genuine recognition of large-scale change was incorporated into the strategy and that dynamic objectives were required. The Biodiversity Strategy for the Goulburn Broken Catchment included objectives of protecting ecological vegetation types, but in the document it explicitly noted that the types of communities would change, that the diversity of current types was being used as surrogate for diversity of future communities:

> It is not the intention of the targets to maintain all species in their present locations and all ecosystems in their present composition (See Steffen et al. 2009). Rather, they are trying to ensure the availability of a range of habitat types across the catchment
>
> *Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015*

Interestingly, however, this sophisticated climate-ready interpretation was articulated deep in a table in Appendix 6 of this document, rather than being highlighted in the main body of the text, and it was not clear that this interpretation was used throughout the various analyses and prioritisation processes associated with the strategy preparation and implementation.

Some other documents did recognise that conservation could not restore biodiversity to a fixed or historical state, and focused instead on maintaining ecological functions, overall resilience or an acceptable standard under climate change. For example:

> The Macquarie Marshes Adaptive Environmental Management Plan (MM AEMP or 'the plan') is not a guide to returning the marshes to some past and inevitably disputed condition or to managing them to maintain a fixed state. It is a guide to restoring ecological structure and function in agreed priority areas. In the broadest sense, the plan is a guide to restoring resilience. Before resilience can be restored, the trajectory of decline must be halted and the condition of the wetlands stabilised.
>
> *Macquarie Marshes Adaptive Environmental Management Plan: Synthesis of Information Project and Actions*

> We need to focus on maintaining and re-establishing ecosystem functions, acknowledging that ecosystem structure is likely to change as species move in response to climate change and other pressures
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

The key feature we were looking for in this review was evidence of objectives that unambiguously meet the climate-ready criteria and do so in contrast to the static versions, not simply being consistent with them. However, there was little evidence that such a shift in thinking had occurred to the point where a climate-ready framing of conservation is demonstrably changing planning objectives and the way they are formulated.

3.3.11 Many management actions have elements that are consistent with or may facilitate a climate-ready approach, but it is not clear that they were explicitly written with this in mind

Even when conservation *objectives* in the documents were not necessarily climate-ready, many documents had had *management actions* which could potentially lead to outcomes that were consistent with a climate-ready approach. Assessment varied depending on the context or details about implementation, but in the majority of cases consistency with climate-ready criteria did not equate to an explicit use of that framework. The discussion below sets out a number of these 'consistent actions' and discusses the extent to which they are potentially consistent with the climate-ready approach.

Interestingly, the management option of ‘do nothing’ was not discussed once in the sample of strategic documents reviewed. One of the concepts behind the climate-ready criteria is accepting that some ecological change is inevitable and might be regarded as acceptable, and management should focus on losses that can be avoided. To implement this managers need a process to decide when to explicitly allow change and when to intervene; hence discussion of when to ‘do nothing’ should be included in climate-ready strategies.

Consistent action one: Cross-tenure land management and partnerships

The scale and scope of the potential change to biodiversity under climate change takes the conservation task beyond traditional boundaries of reserves and national parks and onto other land uses and other jurisdictions. Successful conservation is also likely to require substantially more financial and in-kind resources. For both reasons, cross-tenure management and partnerships will form an important part of a climate-ready conservation strategy.

Cross-tenure management and partnerships were key features in many strategic documents. They could be used to protect values associated with landscapes, manage changing threats more effectively, or facilitate landscape-scale processes that help species disperse and establish in new habitat or cope better with disturbance. For example:

> … the achievement of biodiversity outcomes relies on strong partnerships with other programs and agencies, and with private and public land managers
>
> *Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015*

> 5. Encourage collaborative activities for natural resource management among all stakeholders to take maximum advantage of all potential synergies in natural resource management activities.
>
> *Natural Resource Management Strategy for Southern Tasmania 2010–2015*

It was common for cross-tenure activities to be included in recognition of the need to manage biodiversity beyond the bounds of any program such as the National Reserve System:

> 3.2.1 An improvement in the alignment of sectoral, regional and jurisdictional biodiversity conservation approaches with Australia’s Biodiversity Conservation Strategy
>
> *Australia’s Biodiversity Conservation Strategy 2010–2030*

The cross-tenure perspective was also reflected in a large number of management actions directed towards building and utilising ‘partnership’ type arrangements, or those considered as seeking ‘mutually beneficial activity’ for the delivery of on-ground conservation. For example:

> Achievement of this objective will require a pursuit of actions that both protect and preserve those natural assets that are under significant stress, and facilitate reasonable community use of current assets in a way that minimises the risk of any significant reduction in the utility of these assets for future generations.
>
> *Natural Resource Management Strategy for Southern Tasmania 2010–2015*

However, partnerships and cross-tenure arrangements to manage biodiversity across a broader geographical area or pool resources and increase capacity are ultimately tools – means to achieve ends. For example, cross-tenure management could be directed towards *preserving* the current extent of a woodland, a static objective. Therefore, cross-tenure and partnership approaches are not in themselves climate-ready approaches.

Consistent action two: Managing to a 'benchmark' condition for biodiversity

A key feature of a climate-ready approach to biodiversity conservation is accommodating substantial change in at least some aspects of biodiversity. The use of benchmarks for managing ecosystem condition that anticipate future change or are designed to be independent of changes in type could facilitate this process. Many strategic documents used benchmarks to frame objectives, as part of an adaptive management approach or for monitoring and reporting performance over time. For example, Ramsar wetlands are required to have a description of the 'ecological character' at the time of listing. Any movement of the site beyond defined 'limits of acceptable change' triggers a reporting and investigation process that may lead to management and mitigation measures to ensure that the site's values are maintained. Similarly:

> Identifying thresholds of potential concern helps us to define the upper and the lower levels of accepted variation within a system. In order to decide on an acceptable level of variability, natural resource managers need to know a system's natural variables, the processes that drive variability and the spatial and temporal scales over which variation occurs. They also need to be able to identify critical thresholds at which major changes in a system might occur, causing it to change into an undesirable state – these are thresholds of potential concern.
>
> *Central West Catchment Action Plan 2011–2021*

Although the framework of using benchmarks and thresholds is designed to accommodate some variation in biodiversity and could be used to facilitate a climate-ready approach, the specification of benchmarks as either the 'current', 'ideal' or 'historical' condition of an ecosystem potentially creates a systemic barrier to this. To enable consideration of significant ecological changes under climate change, such an approach would need to include a process for explicitly updating benchmarks in line with observed or expected ecological changes or use benchmarks that are relevant and consistent across a range of potential future scenarios for biodiversity, for example, benchmarking ecological functions.

Consistent action three: Prioritisation of conservation actions

Explicit recognition of different dimensions and attributes and managing for the values associated with them is at the core of a climate-ready approach to conservation. Embedded within this approach is the need to prioritise conservation activities and the implicit (or even explicit) recognition that not everything can be 'saved', resulting in some species or ecosystems becoming effectively extinct. Several documents do explicitly recognise this:

> Existing long-term pressures on biodiversity continue to be the main causes of biodiversity loss, but climate change will magnify the impact of these threats and directly threaten some species and ecological communities. It will be impossible to prevent species and ecosystems from responding to change and it is likely that we will lose some of the biodiversity that we value highly.
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

> As it is not possible to list and protect every species in every place, the best way to systematically conserve biodiversity is to group and classify the natural variation across the state, and then to protect samples of these groupings.
>
> *Protected Areas for the Future: Cornerstones for Terrestrial Biodiversity Conservation*

Many documents recognised the need to prioritise conservation activities and therefore implicitly recognised that not all species can be protected or all degraded ecosystems or landscapes restored to an ideal condition or extent. This is driven by historical experience and failure to effectively halt biodiversity decline or manage all currently threatened species and a recognition that the increased pressures under climate change add to this. Various approaches to species prioritisation were listed.

There was very little evidence that strategies included processes to explicitly prioritise the protection and conservation of biodiversity values associated with ecosystems and landscapes, other than for their ability to help protect species. For example, the *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)* included spatial priorities for conserving landscape outcomes; however, the NSW Biodiversity Forecasting Tool used to generate the priorities is ultimately based on a species-conservation ecological objective function.

There was also a strong impression that prioritisation was driven as much by budget constraints, and the need to be (seen to be) as effective as possible with the resources available, as it was driven by the need to prioritise highly valued elements of biodiversity.

> We believe it is no longer good enough to invest public funds without the discipline of establishing clear national investment priorities or articulating the outcomes we expect to achieve with the investment of those funds.
>
> *Caring for our Country: Outcomes 2008–2013*

3.3.12 Adaptive management and building resilience were the main approaches to dealing with the uncertainties and ecological dynamics resulting from future climate change

Many strategic documents included reference to 'resilience' concepts and 'adaptive management'. In general, strategies aimed to build the resilience of biodiversity, and sometimes communities and regional economies, in the face of climate change, and in many documents this was to be achieved by implementing an adaptive management framework.

However, across the sample of documents there was a high degree of variation in how resilience and adaptive management concepts were articulated and embedded into strategies. For example, 'adaptive management' was simultaneously defined as being a 'management approach' or part of an institutional culture, a governance or management framework and a process or set of actions for coping with climate change. In some documents, building resilience was used to mean implementing actions that were thought to make biodiversity cope with disturbance and change better (e.g. maintaining connectivity). In others it referred to an iterative way of actively managing interlinked dynamic social and ecological systems. Interestingly, Central West CMA and Goulburn Broken CMA, the agencies with the most sophisticated resilience approaches, developed them as solutions to managing complex NRM systems facing collapse from the intensity of human uses, not specifically as a response to climate change.

Particular aspects of these strategies that support a climate-ready approach included:

- Interpretation of the 'problem' of biodiversity conservation as the management of a socio-ecological system (e.g. *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP 2)*)
- Recognition that variability is normal and change as a result of climate change is inevitable, but with recognition that this does not necessarily undermine the structure and function of the system and its value to the community (e.g. *Central West Catchment Action Plan 2011–2021*)
- Use of state and transition models to frame planning processes and to identify key variables, drivers of change in variables and thresholds in the socio-ecological system (e.g. *Central West Catchment Action Plan 2011–2021*)

- A learning-by-doing approach to management, whereby assumptions and interventions are tested and refined over time in the face of new information (e.g. *Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015)*
- Recognition of different types of values associated with biodiversity conservation and different types of knowledge that could contribute to conservation (*No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*).

However, in many documents where a resilience approach was proposed as a response to climate change, there was limited evidence of either any systematic implementation of resilience concepts or how the approach would actually improve outcomes under climate change. In particular, there was poor articulation of the aspects of the socio-ecological system to be the target of resilience (the 'of what'). The pattern that emerged was that resilience was being used to imply that some resilience-building management could be applied to *prevent* the pressures of climate change leading to significant ecological change.

This emphasis on using resilience to *prevent* impacts of climate change, without a clear articulation of what is being made resilient, is clearly not climate-ready. A climate-ready interpretation of resilience would include explicit acknowledgment that substantial change to the ecological system is likely, but as that change occurs the system can maintain the resilience of some specific characteristics. That is, the resilience of these characteristics is the property of the system that is maintained as other key properties change. In other words, there is a critical difference between resilience *to* climate change (an ecosystem resisting change due to climate change), and resilience *under* climate change (where ecosystem resilience is a property that is maintained as the identity of the ecosystem changes). Some proposed actions are potentially consistent with this interpretation (e.g. restoring habitat, building connectivity, restoring ecological flows), but no documents presented resilience with this interpretation, and it is arguably inconsistent with the standard definition of resilience that hinges on a system being able to 'retain essentially the same function, structure, identity and feedbacks' (Walker et al. 2004).

3.4 Discussion and observations

This review found that climate change is now recognised as a significant issue in Australian biodiversity conservation strategies, and agencies at all levels are making progress in understanding and addressing the implications of climate change for biodiversity conservation. The review explored progress toward planning for significant climate change using three climate-ready criteria focusing on accommodation of large-scale ecological change, uncertainty about trajectories of future ecological change, and explicit impacts on multiple socially valued dimensions of biodiversity. In Chapter 2 we argued that for strategies to meet the challenge of conserving biodiversity under climate change, something akin to a paradigm shift is required in the framing of conservation. The overarching finding of this chapter was that while there is progress, and some examples of substantial progress towards strategies becoming climate-ready, in the main there is a significant gap between current approaches to conservation and the climate-ready conceptualisation of conservation developed in Chapter 2. Below we outline a number of emerging patterns from strategic conservation documents that suggest current barriers and enablers towards climate-ready conservation decision-making in Australia.

3.4.1 Objectives not described in terms of desired biodiversity outcomes – a barrier

In general, the objectives in the set of strategic conservation documents we reviewed were not articulated in terms of desired outcomes for biodiversity; where desired outcomes were included in documents, they were typically not clear enough to differentiate between acceptable ecological change and loss to be avoided. Under a stationary climate this may not be a significant issue as the implicit desired outcome is essentially minimal change from the current natural state. However, in the face of significant and widespread ecological change, clarity about future desired outcomes will be far more important; we argue that future objectives need to accommodate both the aspects of biodiversity that *society aspires* to experience and appreciate and the ecological feasibility of maintaining those aspects as the climate continues to change. Decisions about these objectives will need to distinguish between changes in biodiversity that are inevitable and might be accepted or even facilitated, and those that are undesirable and the target of management. Objectives will then need to be articulated clearly enough to convey that distinction to planners and managers implementing conservation. This is a critical element of the shift to the climate-ready conceptualisation of conservation.

3.4.2 Ambiguity about ecological means and ends – a barrier

Conservation documents tended to focus more on management actions and their direct outputs than on the desired outcomes for biodiversity that might result from these actions. This approach does provide direction for programs and on-ground management, and leads to targets that are more within the control of implementing agencies, as opposed to focusing on outcomes that are subject to many uncertain factors such as ecological dynamics, climate change and other threats. A focus on management inputs and outputs is logical for implementation; however, if the desired outcomes are not clearly specified (see above) then ambiguity between the means of conservation and the ultimate objectives can arise. This is exacerbated by the widespread use of species as surrogates or proxies in biodiversity conservation, and the general lack of distinction between the utility of threatened species *as a management tool* and the social values associated with species. While proxies are useful, in planning for climate change it will be necessary to clearly distinguish between means (processes/actions) and ends (outcomes) in the assessment and development of proxies that are effective under climate change.

This ambiguity about means and ends was very apparent in statements about ecosystems and landscapes. In the context-setting text in most documents, it was very clear that ecosystems and landscapes were valued by society in their own right for a wide number of reasons. However, in the expression of landscape and ecosystem conservation in objectives and management sections, the documents largely, although not exclusively, focused on the need to manage at these scales to increase the prospects of species or ecological communities surviving. While species do need ecosystems and landscapes, and ecosystems and landscapes would be empty without any species, the valued outcomes for each are distinct. Under significant ecological change it is clear that threats to values associated with species, ecosystem and landscape will be less correlated than under stationary climates, therefore there is a need to be explicit about the specific outcomes for different dimensions of biodiversity as well as the cross-scale management means.

3.4.3 Widespread use of related concepts – an enabler

While as a set the strategies were not climate-ready, they did include widespread use of concepts related to the climate-ready criteria. For example, many documents included:

- recognition that climate change will affect biodiversity
- acceptance of some change and dynamics (e.g. resilience approach) and of not being able to prevent all loss (e.g. the need to prioritise)
- uncertainty about the future (e.g. need for adaptive management)
- multiple values associated with biodiversity (ecosystem services)
- the need to move beyond species (focus on ecosystem function)
- more focus on ecosystems and landscapes (ecosystem and landscape approaches).

While the extent to which these concepts were implemented or the intent was substantially short of being climate-ready, their presence is encouraging, showing that a foundation for climate-ready thinking exists within conservation agencies in Australia.

However, while familiarity with the concepts potentially lays the basis for them to be developed to address climate change, this familiarity can itself be a barrier as it may be harder to engage partners and stakeholders in a new conversation and narrative using language and terms that are familiar but that carry different intent. For example, there are large conceptual differences between 'resilience *to* climate change' and 'resilience *under* climate change' or 'managing landscape values' and 'the value of landscape management'.

3.4.4 Entrenched static paradigm – a barrier

While the widespread inclusion of concepts related to climate-ready criteria is an enabler, the extent and way in which they were implemented reflected an overarching 'static' framing of conservation. The objective of current strategies, while varied, could largely be characterised as aspiring to maintain populations of species (especially threatened species) and communities in their current locations with habitat and threats managed at landscape scales. Very few strategic documents clearly articulated 'dynamic' objectives, nor clearly expressed expectations for large-scale change or loss. The use of adaptive frameworks was potentially appropriate for managing uncertainty and risks, but was largely used within a 'static' context. Moreover, no document discussed the implications of the significant uncertainty about the detail of future climate-driven ecological change, or the need to focus on societal values associated with ecosystems and landscapes as they change. An overarching static framing was also apparent in the widespread focus on threatened species and ecological communities either in their own rights or as proxies for broader biodiversity values, and in language presenting climate change as a threat to be managed like any other, rather than as a pervasive driver of change affecting all biodiversity that requires a fundamental re-assessment of what it means to conserve biodiversity. We argue that not only do the climate-ready concepts need to be included, but strategic documents also need to be framed by those concepts to avoid an implicit or explicit embedding of the static interpretations and aspirations in objectives and management actions.

3.4.5 Validation of the climate-ready criteria – enabler

The process of reviewing these conservation documents reinforced the validity, relevance and usefulness of the set of climate-ready criteria as a tool for enabling the adaptation of biodiversity conservation to climate change. While many objectives were crafted in a way that made them hard to assess, there were enough we could assess with the criteria to distinguish between those that were climate-ready and those that were not.

For the objectives that were not climate-ready or were ambiguous, it was frequently clear how they could be modified to meet the criteria and how this could lead to different management actions. In particular, there were situations where assessing objectives against the climate-ready criteria revealed management actions that might be inefficient, ineffective or even counter-productive in the face of significant climate change, most notably, attempts to resist small amounts of climate change that would hinder adaptation to larger amounts of change – so called 'adaptive resistance'.

3.4.6 Nested institutions – an enabler and a barrier

The hierarchical linking that was observed across many strategic documents highlights the need for adaptation to be collaborative across institutions. Review and development of climate-ready objectives at a high level could provide a mechanism for rapid propagation of adaptation to subsidiary strategies and the agencies responsible for them. Some of the most climate-ready objectives were found in regional strategic documents, so there is significant opportunity for adaptation capacity to develop by sharing across and up the institutional hierarchy. However, in several situations there were clashes between climate-ready innovation at the regional level and more static state-level objectives, priorities and management prescriptions provided to the regions. Hence, without the willingness and institutional ability to learn from innovation at 'lower' levels, a strong hierarchy in conservation institutions and documents can be a barrier to adaptation.

3.4.7 Broader socio-economic contexts

The strategic documents clearly illustrated that biodiversity management has the potential to contribute to a wide range of outcomes beyond those directly associated with the state of species and ecosystems. Even though biodiversity was the focus of most of the documents reviewed, these associated social and economic objectives are clearly important enough for the relevant agencies to make strong connections to biodiversity management. This highlights the potential synergy between adaptation of biodiversity conservation and adaptation in other sectors, and it is reinforced by the general relevance of our climate-ready framing to other sectors. The broader linking of biodiversity management to other social and economic policy outcomes is also relevant to considerations of the policy review processes by which conservation and NRM strategies might be revised over time.

4. CASE STUDIES

4.1 Purpose of the case study approach

The review and assessment of conservation documents provided broad sampling of contemporary conservation thinking and decision-making in Australia, and the implications of significant levels of climate change for it. This part of the project used four case studies with Australian conservation agencies to explore the implications of the climate-ready approach, developed in Chapter 2, with conservation policymakers and planners. Importantly, the case studies enabled much greater reference to the thinking and operational contexts of decision-makers and their agencies. The case studies were also used to reflectively test the climate-ready conceptualisation. The case studies consisted of a series of workshops with research partners drawn from Commonwealth, state, regional and local biodiversity management agencies, and a variety of additional engagements. The objectives of the workshops were to:

- assist the research partner in developing a better understanding of the potential impact of climate change for their region or issue
- explore the implications of climate change for their current conservation objectives
- explore the scope and potential opportunities and barriers for developing climate-ready conservation objectives.

Specific topics covered in each workshop were:

- presentation and discussion of key conclusions about how biodiversity will be affected by climate change, formalised in terms of the climate-ready propositions
- identification of current biodiversity conservation objectives; for this activity, two to seven objectives were chosen by research participants from current strategic documents and discussed in the context of climate change and climate-ready criteria
- identification of how biodiversity is experienced and appreciated by the individuals at the workshop to begin to explore the breadth of aspects of biodiversity that are valued by society
- self-assessment of whether current objectives used in management agencies are feasible under possible future climate change scenarios, using the set of climate-ready criteria
- reflection on issues relating to developing climate-ready objectives in the language and concepts used by the research partners.

Research partners were also given the option of a follow-up meeting to discuss any critical issues they wished to explore further.

The research partners for this project were Northern Rivers Catchment Management Authority (CMA); Goulburn Broken CMA; Tasmanian Department of Primary Industries, Parks, Water and Environment (Resource Management & Conservation Division); and the Australian Government Department of Sustainability, Environment, Water, Population and Communities (Wetlands Section, for a focus on Ramsar wetlands). Workshop participants came from the partner agencies and their networks of partner agencies.

Each workshop was facilitated by Paul Ryan of Interface NRM (http://www.interfacenrm.com/) who is a professional NRM facilitator and pioneer in the application of systems and resilience thinking to NRM issues in the Australian context. The planned framework for the workshops is set out in Figure 7.

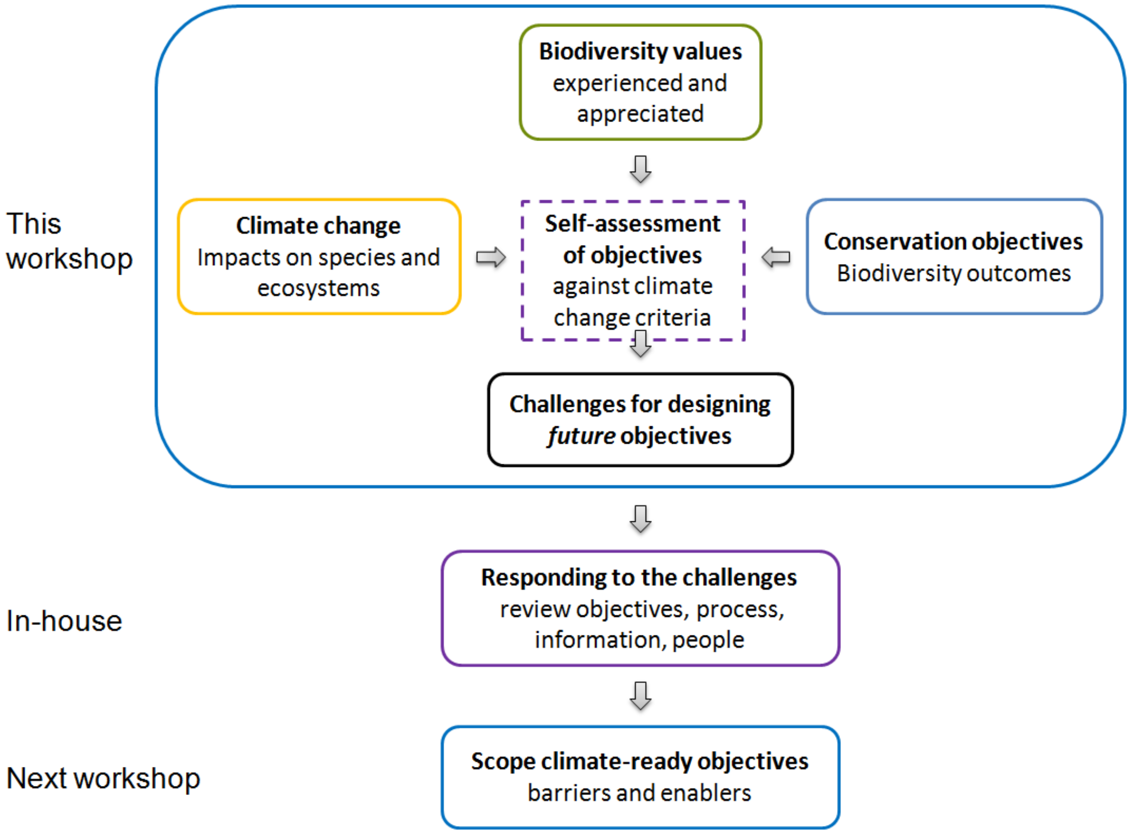


Figure 7: Structure of workshops with conservation agency research participants

Processes and content of each workshop were adapted to the specific institutional and geographic context of the research partners. All workshops centred around highly engaged discussions of key topics, although none were able to complete all activities as intended. There were two reasons for this. First, a lack of readily available outcome-oriented objectives (discussed later in this chapter) hampered planned discussion on climate readiness of conservation objectives, and considerably more time was spent elucidating the significance and meaning of objectives. Second, the workshops were originally designed to be carried out over two days but, due to time limitations faced by research partners, had to be compressed into a one-day event. Although the compressed process was still of value to the research, the shortened time frame meant that relatively more emphasis was placed on discussing the implications of the climate-ready propositions for the agency, rather than on developing future climate-ready objectives.

A key part of the climate-ready approach is considering how climate change affects the multiple different aspects of biodiversity that are valued by society, and developing objectives to cover the breadth of these values. To illustrate this breadth in the workshops, participants were asked to provide a photograph or quote that represented how they experienced and valued biodiversity of the region or topic, and to describe that connection in a few sentences. The group then discussed the breadth of aspects of biodiversity that were described. It was recognised in all the workshops that it was not the role of biodiversity policymakers, planners, or researchers to define or second-guess the scope of the relationships different individuals and communities have with biodiversity. Rather, the intention of this exercise was to highlight the broad range and multi-dimensionality of such relationships.

The process was phenomenally successful; participants readily spoke ‘from the heart’ as individuals, not agency representatives, and many provided short but sophisticated narratives often capturing dynamics or processes and not just describing individual species or places (a sample of these are summarised in Table 7). The process provided a huge variety of perspectives on biodiversity, often in contrast to the narrow framing of objectives as discussed in other sessions in the workshop.

Following this table, the chapter presents the findings of each case study through a brief discussion of the region or issue, the potential impact of climate change, factors that either support or need further consideration for the adoption of the climate-ready approach and then any other issues that were raised. The chapter ends with a discussion of the key issues that were observed across all case studies.

Table 7: Summary of key values workshop participants expressed in the photo session where they discussed how they experience and appreciate biodiversity

Northern Rivers Catchment, NSW	Goulburn Broken Catchment, Victoria	Tasmanian Central Plateau	Ramsar and other wetlands
Sense of Place • The social 'potential' or interest of a place • Familiarity/connection with the past • Contrast with the familiar (i.e. experiencing something different) • Cultural connection • Landscape imposing itself on you/us *Condition, 'health' resilience* • Vulnerability-potential • Healthy, functioning • Dynamics – new opportunities • Function, dynamics, bounce back, resilience *Naturalness* • Lack of human interference • Pristine • Space/wilderness • Unmodified *Significance* • Threatened ecological communities • Ramsar listing *Quantity/Extent* • Bushwalking • Quantity • Space	• Potential for healthy ecosystems for water bird breeding events (ibis) • Value birds for agricultural pest control • Refugia • Frogs – they are sensitive creatures to environmental change, a species we will lose the fastest and are an indicator species for the web of life (e.g. snakes) • Frogs on farms – connection to nature/indicator of future changes to the environment • Platypus/curlew – hidden species, not 'publicly valued' or understood. Good indicator species for ecological health • Wilderness areas – big intact areas of bush • Platypus – symbolism of evolutionary history and emblematic of Australia – useful teaching tool about the impact of willows on the environment • Wetlands – healthy functioning landscape • Aerial shot of river – healthy habitat for fish and platypus • Hills of Goulburn Broken – memory of families • River – stories and memories of high quality habitat • Sheep/paddock/farm – memory of farmer lifestyle – farm products. Also a landscape that has details at different scales • Forest wetland – reminder of family farm, familiarity and memory of a good lifestyle	• Experiencing biodiversity and geodiversity natural values as well as experiencing 'landscape' • Lakes and water – an iconic part of Tasmania • Intact landscape • Can drink the water • Sense of time expressed through geology/trees – feeling of being in an old place • Colour palate: grey/black unique in state • Harsh environment – reflected in the vegetation • Iconic biodiversity and geomorphic features that are essentially 'Tasmanian' – e.g. sphagnum bog, pencil pines • Spiritual heart of Tasmania • Wilderness • Loved area – perhaps 'over loved' • Recreation of various types • Wilderness – high level of endemic species over short ranges • Living fossils – aged/old endemics • Area is associated with the identity of Tasmania • Sounds of birds/feeling of chill in area/smell of area – part of the 'Tasmanian' experience • A sense of community expressed through the 'mountain huts'	• Open space for biodiversity to persist without human intervention • Connection with nature • Balance between human use and preserving the beauty without killing it • Scientific research/collaboration for working towards restoration • Spiritual values • Space to recognise Indigenous culture and connection to land • Direct experience with a charismatic species/existence values • Resources for food • Opportunities to educate about value and biodiversity • Experience on a daily basis • Multiple levels of experiences – from local to remote • The Lorax (Dr Seuss) – experiencing hope/despair about biodiversity • Bringing together different cultural values • Recreational opportunities/social diversion • Invokes childhood memories • Value birds and opportunity to study biodiversity

4.2 Northern Rivers Catchment Management Authority

Research Partner: Northern Rivers Catchment Management Authority. Representatives of the NSW Government and the Coffs Harbour Council also participated.
Workshop date: 17 August 2012
Location: Coffs Harbour

4.2.1 Background

The Northern Rivers Catchment Management Authority (NRCMA) region is located in the north-eastern corner of New South Wales (NSW) from the Queensland border south to the Camden Haven catchment and inland to the eastern slopes of the New England Tablelands. Covering an area of 50,000 square kilometres, the region is more than half (60%) freehold tenure, with the remainder forming Crown Land, National Park and State Forest.

The NRCMA region is recognised as an extremely biologically rich part of Australia and has co-occurrence of both temperate and tropical species (Burbidge 1960). It is considered to be a ‘genetic hotspot’, an important source of genetic material for future species evolution and is considered a potential ‘climate refuge’ under future climate change scenarios.

It is the third most biodiverse area in Australia. The region contains a large number of endemic species and although it occupies just 6.3% of NSW, it supports over 40% of the State’s threatened species, including around 70% of threatened frogs, 75% of threatened birds, 60% of threatened mammals and 40% of threatened plants. In addition, one-fifth of the State’s threatened ecological communities are known to occur in the region. Key biodiversity features identified by the workshop participants include:

- the region having a high-level functioning trophic system – i.e. a largely intact predator–prey food web
- most biologically diverse region in NSW
- high social capacity (in managing/restoring), vs. community apathy (climate change, don’t know/don’t care about biodiversity), but many come here to live or holiday for the environment
- Large areas of vegetation (e.g. wilderness areas); however, the condition of much of it is unknown
- geographic overlay between (sub-)tropical and temperate for both terrestrial and aquatic ecosystems
- much of the escarpment is in reserves and vegetated, while the coastal floodplain ecosystems are highly fragmented, due to agriculture and urban development
- some invasive species are now ‘out of control’ (naturalised?) and have become important faunal habitat in their own right (e.g. camphor laurel)
- along with its outstanding biodiversity, the region also supports a large and growing human population with a number of urban growth areas along the coastal margins.

4.2.2 Climate change in the NRCMA region

The NSW Government’s Climate Change Office has commissioned modelling showing that temperatures within the region are virtually certain to rise in all seasons, particularly during winter. Daily average minimum temperatures are projected to increase by 2–3°C by 2050. Spring rainfall is not expected to change. Summer and autumn rainfalls are expected to increase slightly, and those of winter are expected to decrease slightly. Evaporation is likely to increase moderately across all seasons.

The impact of the El Niño cycle is likely to become more extreme and sea level is virtually certain to rise about 0.4 m above 1990 mean sea level by 2050. Flooding extent, frequency and height are likely to increase, and there will possibly be increases in fire frequency.

Key impacts on the region's ecosystems include:

- Sea level rise and shoreline retreat are likely to exacerbate the current significant modification and loss of intertidal and sub-tidal communities. This is likely to further stress already stressed important nurseries for fish stocks and result in decline in some species.
- Higher temperatures, altered fire regimes and altered hydrology (with wetter summers and drier winters) are likely to bring about changes to structure, species composition and species abundances – especially in the fire-sensitive ecosystems of the region such as freshwater and forest wetlands, wet coastal heaths and dry rainforest.

Values arising from the photo session with the NRCMA are set out in Table 7.

4.2.3 Pathways to becoming climate-ready

Workshop participants described the region as 'intense' – lots of biodiversity and lots of threats – and it is seen as a potential future climate change refuge.

Key factors in assisting the region and the NRCMA become climate-ready are:

- a high level of social capacity, skills and interest in biodiversity within the community, particularly from people who have recently moved to the region for the sea-change lifestyle
- broad acceptance of the implications of climate change for biodiversity and of the climate-ready approach, but challenged and cautious about the repercussions for planning and management
- the workshop was conducted just as a new draft plan was being developed; discussions spanned objectives in the old and new plans
- very good planning processes, reflected in a high quality regional plan that focuses on resilience and ecologically functional landscapes. However, the planning focused more on 'process' or 'input' (e.g. managing threats), than explicit ecological outcomes that might result. The new (draft) plan has explicitly used elements of the climate-ready conceptualisation developed in this project. Key climate-ready aspects of the plan included:
    - the key environmental objective is 'ecologically functional landscapes' that attempt to incorporate all three attributes of a 'dynamic' approach: habitat extent and connectivity (landscape and quantity of biodiversity), diversity (variety of species), and condition and re-establishment or maintenance of the tropic structures (faunal assemblages) (quality of ecosystems)
    - within this objective, the aim is to maximise the potential of the landscape in whatever form it takes. That is, 'resilience' is defined as 'providing opportunity for a patch of biodiversity to do what it is going to do under climate change' – i.e. the notion of facilitation, rather than static resistance to change.
    - two new actions to facilitate climate readiness were included in the second plan as a result of this research. The first considers the need to explore adaptation options for land- and seascapes. The second focuses on raising awareness and understanding of the implications of climate change.

- recognition that protecting 'every species' is probably no longer possible. A workshop participant commented that: 'the species approach is getting us into knots'; 'Everything is threatened, [it's] not very useful'. Related to this is a recognition that the region is struggling to control some weeds such as camphor laurel and lantana – which raises questions about whether we should just accept it.
- the ability of biodiversity to recover; for example, large areas of bush have regrown on old dairy farms, but the quality of the habitat is not nearly of the same quality as original native vegetation ('rubbish quality')
- focus on landscape function and ecological processes, with species and other priorities flowing from that
- beginning to think about how to deal with habitats that are considered to currently have low biodiversity value but might improve. Should management focus on areas with high biodiversity now or on the potential to improve biodiversity and processes in the future?

Areas that require attention for the region to become climate-ready are:

- plans that are substantially action- and target-focused – such plans have no clear articulation of desired biodiversity outcomes, which makes assessment against the climate-ready criteria difficult
- a planning and management culture that is very data driven; the region has significant datasets and so it is unclear how to plan and operate given the uncertainty (which equates to lack of data) about impacts of climate change
- species-based spatial prioritisation: the CMA is required to use a species-based spatial prioritisation process, even for their landscape function objectives. This is driven, in part, by spatial prioritisation processes based on species objectives produced by the NSW State Government, so deriving landscape-scale objectives is somewhat influenced by concepts of ecological requirements of species rather than human desires for landscapes
- loss of community capacity: as the urban population increases, and the rural population declines, the region is losing the local knowledge of how the landscape works
- institutional barriers: communication and engagement on adapting to climate change across all stakeholders (community and government departments); working within a structure that does not easily permit strategies and activities that are not consistent with objectives and goals established at 'higher' governance scales
- community perception: community had a high level of concern for species and composition of bushland (i.e. the look of it) but little understanding of the functioning of a healthy biodiversity landscape
- community demand: pressing need from regional councils to answer questions about where/what/how to plant vegetation
- community perception: it was recognised that areas undergoing regeneration may be modified to some extent (e.g. by grazing) and may have high conservation value in the future. However, such areas are typically regarded as very poor quality and not very valuable, because they are not in 'ideal' condition
- local government biodiversity plan needs to be linked to other issues/legislation to have social traction.

Other questions and issues raised include:

- if a component of biodiversity serves a function and is working in the environment, – does it matter if it is introduced or not? For example, if predator functions are fulfilled by feral dogs, does it matter that they are not dingos?
- should the Catchment Action Plan (CAP) be analysed for climate readiness for other NRM issues and perspectives, such as agriculture or lifestyle farming?
- key question: how do we ensure the capacity of the ecosystem to 'self-organise' under future climate regimes?
- current objectives consider social/economic extent, but nothing about type of ecological community (e.g. 'landscapes for recreation', 'manage water security', etc.).

4.3 Goulburn Broken Catchment Management Authority

Research Partner: Goulburn Broken Catchment Management Authority
Representatives of the Victorian Government also attended
Workshop date: 23 August 2012
Location: Shepparton, Victoria

4.3.1 Background

Situated in northern Victoria and part of the Murray–Darling Basin, the Goulburn Broken Catchment Authority (GBCMA) region covers 10.5% of Victoria and provides 11% of the Basin's stream flow. The region supports major agricultural (dryland and irrigated), food processing, forestry and tourism industries. The annual economic output of the Shepparton Irrigation Area is $4.5 billion. The region has approximately 8,000 square kilometres of public land. Over 200,000 people live in the catchment, with rapid population growth occurring around centres within commuting distance of Melbourne and the City of Greater Shepparton.

The region's biodiversity assets are diverse, with the catchment crossing eight bioregions: the Victorian Riverina, Goldfields, Murray Fans, Northern Inland Slopes, Highlands – Northern Fall, Highlands – Southern Fall, Central Victorian Uplands and Victorian Alps. The region is home to a great diversity of native plants and animals, several of which are endemic; however, recent (2007 and 2009) catchment condition reports have found the biodiversity in a poor to good or poor condition. Many species of plants and animals in the catchment are threatened because of the legacy of past activities. Key biodiversity statistics for the catchment are:

- 60% of the catchment has been cleared, although the extent of clearance is larger in areas suitable to agriculture
- 13% of native plant species and 64% of ecological vegetation classes are listed as threatened, endangered or vulnerable; 22% of fauna are threatened
- the majority of remaining wetlands are considered to be in poor to moderate condition
- almost 30% of streams and waterway reaches are considered poor/very poor; 54% rated as moderate and 17% rated as good/excellent
- some improvements in native vegetation loss have been achieved by large-scale revegetation, remnant protection and grazing management programs.

Values arising from the photo session with the GBCMA are set out in Table 7.

4.3.2 Climate change impacts in the GBCMA region

The Goulburn Broken catchment is already experiencing increased temperatures, and future climate is expected to be hotter and drier compared to current conditions. By 2030, average temperature is expected to increase by about 0.9°C with a slightly higher increase in summer. Average rainfall is expected to decrease by 3–7% and potential evaporation is expected to increase by up to 4%. The impacts of climate change are more likely to be felt in the region through changes in extreme weather events (e.g. rainfall, temperature, frosts). Projections indicate that in the northern part of the catchment, by 2030, the number of frost days is expected to decrease from 46 to 35, decreasing even further to potentially 17 by 2070. Days over 30°C are expected to increase from the current 60 to 69 in 2030 and potentially 97 by 2070. Days over 40°C could double from currently 1 day per year to 2 in 2030 and 6 by 2070. The impacts for the southern section of the catchment follow similar patterns. Average total rainfall is expected to decline, but the intensity of heavy daily rainfall is likely to rise in most seasons. It is likely that the region will experience more drought events and increased risks for bushfire events.

The impacts of climate change in the region will combine synergistically with other existing threats to biodiversity (e.g. habitat loss, water diversion, weed and pest infestation or altered fire regimes). In its 2010 assessment of climate change in the catchment, the GBCMA identified a number of key assets subject to extreme threats (defined as high probability and high likelihood). These include:

- increase in the occurrence and severity of fire on flora and fauna and on rivers and streams
- increase in stream salinity
- changes to pest distribution and species impacting on river streams and wetlands
- changes in snow regime impacting on native vegetation and threatened species.

4.3.3 Pathways to becoming climate ready

The GBCMA region has a long history of innovation in NRM and has been actively engaging with the challenge of how to manage their biodiversity assets in the context of a changing climate.

Workshop participants identified elements that support being able to cope with climate change in the GBCMA planning processes:

- a high level of social capital and leadership on NRM issues arising from individuals and families maintaining strong emotional attachments to the community and region; self-identification as ‘leaders’ in the biodiversity conservation/NRM field; people in the Goulburn Broken region are pioneers in the development of ecosystem services approaches to catchment management and resilience thinking at the catchment scale
- broad recognition that the current Catchment Management Plan is inadequate to address the challenge of climate change; people are actively interpreting the Plan in the context of a ‘changing climate’. For example:
    - the term ‘viable populations’ in the Plan is interpreted as not referring to specific species, but to ‘any future species’
    - management indicators in the Plan are interpreted not as detailed, absolute measures of success but as ‘signposts’ for future direction of work; however, people question if current indicators are suitable for managing under a changing climate

  - people prioritise management objectives and interpret those of lower priority as 'short or medium run' objectives that are not suitable for the longer run.
- the CMA had already explicitly incorporated objectives for multiple dimensions of biodiversity (species, ecosystems and landscapes) into planning processes and had explicitly dynamic objectives for each of these dimensions
- the plan is explicitly seeking ecological outcomes; it was developed with terrestrial biodiversity in mind, and has recently been linked to aquaticbiodiversity outcomes. However, there are currently no good measures for these outcomes. Such measures would include various ecological processes; for example, there are good data on gene flow which can be used to look at landscape and habitat connectivity
- institutional 'confidence' and excellent processes to openly discuss, question and alter assumptions, mental models and approaches in light of new information or experiences
- broad recognition of the limitations of current approaches to biodiversity conservation, in particular, the limits around the 'threatened species' approach
- general acceptance that things 'can't be kept the same' as they currently are; the GBCMA has abandoned the use of 'historical baselines' in determining ecosystem health and is seeking to use 'future baselines' – although unsure what this means
- active community groups do on-ground work and are considered by planners as providing a 'reality check' for plans and objectives.

Identified key barriers include:

- local conservation priority setting is shaped by requirements to meet investment targets and priorities established by state-wide modelling processes. This process (termed a 'black box') is considered to adopt a static conceptualisation of biodiversity conservation and is identified as 'killing off' discussions about different biodiversity values and being too heavily driven by species considerations. If the region wishes to invest in other biodiversity projects, it is required to justify this decision against the static framework identified by the state processes
- different on-ground groups wish to participate in objective setting but are usually motivated by sub-regional factors and find it difficult to commit to regional- or state-scale objectives that may not align with local ones.

Key challenges, issues and questions raised by the workshop included:

- how to manage uncertainty under climate change
- definition of issues – confusing 'means' and 'ends' and lack of clarity over key terms
- definition, use and communication of new (complex) ideas and objectives and lack of clarity over key terms
- determining the appropriate scale for establishing objectives – and ensuring that the objectives are meaningful for on-ground works
- generating creativity and capacity to continue innovation in biodiversity conservation
- some outcomes (e.g. viability of threatened species) may not be a good indicator for the biodiversity vision
- speed and scale of what is being done needs to increase to achieve biodiversity vision ('how, where, how quickly, when')
- also constrained by State processes, e.g. state maps/priorities are not similar to CMA priorities or of local stakeholders.

4.4 Tasmanian Central Plateau

Research Partner: Resource Management & Conservation Division of the Department of Primary Industries, Parks, Water and Environment. Representatives from other parts of DPIPWE and various other State Government agencies responsible for biodiversity management, with a specific focus on the Central Plateau area of the Tasmanian World Heritage Area, and from the Tasmanian Land Conservancy, Hydro Tasmania, University of Tasmania and NRM South also attended.

Workshop date: 28 August 2012
Location: Hobart, Tasmania

4.4.1 Background

The Central Plateau conservation area is an 890 square kilometre area of alpine lake landscape in Tasmania and forms the most north-easterly portion of the Tasmania World Heritage Area (WHA). It is bound to the north-east by the Great Western Tiers, to the west by the Walls of Jerusalem National Park and the east and south by freehold or Hydro Tasmania land.

The Central Plateau's most notable features are the numerous lakes and tarns, which form a unique alpine landscape in Australia. Although part of the WHA, and managed under the WHA plans, the Central Plateau area is not considered 'wilderness' and is managed for the purposes of self-reliant recreation and cultural values.

Values arising from the photo session with the Tasmanian NRM managers are set out in Table 7.

4.4.2 Pathways to becoming climate-ready

Factors that support the region becoming climate-ready:

- intact landscape – and wilderness area that is loved and valued by community
- strong recognition of 'landscape' as a valued dimension of biodiversity as well as importance placed on healthy ecosystems and species
- high capacity in lead agency to anticipate, understand and plan for climate change adaptation.

Challenges that require attention for the region to become climate-ready:

- lack of formal collaborative arrangements between science and land management agencies and a mismatch between the scientific work (which reflects the interests of scientists) and the needs of land management agencies
- range of land tenures managed by different land management agencies and private land owners with different objectives and variations in their capacity to anticipate and plan for the impacts of climate change
- no clear outcome-oriented biodiversity objectives currently in plans
- unclear how to set objectives with such a large amount of uncertainty
- getting the right people involved in the climate-ready preparation – what engagement models should be used?
- competing objectives (even within agencies), which is likely to increase under climate change and is driven by competing legislative frameworks; this was identified as a potential major challenge
- climate change impact projects – need assistance in understanding and analysing the data – questions regarding what metrics to use/to develop to help understand and monitor change

- no weather stations in study area (few in Tasmanian Wilderness WHA) that are appropriate for monitoring the climate change impacts on the WHA
- day-to-day management is driven by 'lists' and 'actions' and 'approaches' under existing legislation and the legislative context of planning
- lack of senior management/political understanding and support for incorporating climate change into biodiversity planning
- slippery words and multiple meanings of words – very confusing and makes issues difficult to discuss, especially among diverse agencies
- ready access to good planning tools but lack of confidence in using them (e.g. database tool/analytical tool):
    - need resources to maintain and improve databases
    - need courage to look at priorities and stop doing some things
    - need confidence in tools (variable output depends on users).

Key issues raised:

- compound impacts – lots of other impacts on biodiversity as well as climate change, therefore may need to think about 'human impacts' and not just climate change; this view is driven by funding-body language and priority setting
- queries as to exactly how to make biodiversity planning dynamic – tool? Update plans regularly?
- how to create the political space for changes in strategy in response to climate change?
- how do we do pre-emptive climate change–impact planning early on in the transformation?
- don't know when 'enough change is enough' and requires intervention versus letting something go
- raises questions about whether it is possible to separate measures of condition from ecosystem type?
- agreed that this was possible (e.g. by measuring change in net primary productivity), although there is no single measure of ecosystem health. Could look at historical data for suitable benchmarks.

4.5 Ramsar Wetlands – Australian Government

Research Partner: Wetlands Section, Department of Sustainability, Environment, Water, Population and Communities (SEWPAC). Representatives from the Murray–Darling Basin Authority and the National Water Commission also attended the workshop.
Workshop date: 8 November 2012
Location: Canberra

4.5.1 Background

The Ramsar Convention[7] aims to promote the conservation of internationally significant ('Ramsar listed') wetlands and 'wise use' of all wetlands. There are 64 listed Ramsar wetlands in Australia, and they are predominantly managed by state governments; the Australian Government has responsibility for implementation of the Convention and for providing leadership and guidance on wetland management.

The criteria for listing a wetland under Ramsar requires that it either be a representative example of a wetland type, a rare or unique wetland, or support

[7] The *Convention on Wetlands of International Importance especially as Waterfowl Habitat* (Ramsar (Iran), 2 February 1971; www.ramsar.org) is commonly known as the Ramsar Convention.

vulnerable or endangered species or ecological communities. Although wetlands can be listed for their geomorphological representativeness, the nine criteria for listing are mainly species-focused and aim to protect values associated with species and other dimensions of biodiversity:

> Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening.
>
> *Ramsar Convention 1987, Article 2.2*

Once a wetland is listed, countries are required to maintain the 'ecological character' of the wetland. Ecological character is defined as a combination of ecosystem components, processes, benefits and services that characterise the wetland at the time of designation for the Ramsar List (Ramsar Convention 2005). Thus management of the wetland incorporates broader values associated with ecosystem and landscape dimensions of biodiversity.

A key tool in the management of Ramsar wetlands is the development of Limits of Acceptable Change (LACs). These recognise that wetlands vary naturally and that the ecological character is a not static point; the LACs define the bounds on that variation at which point change must be reported to the Ramsar Convention and further investigation undertaken.

Values arising from the photo session with the Ramsar Policy Team of SEWPAC managers are set out in Table 7.

4.5.2 Climate change and Ramsar-listed wetlands

Climate change is recognised as a threatening process to several Australian Ramsar-listed wetlands and managers are encouraged to consider it in preparing risk assessments (DEWHA 2008). Key threats associated with climate change (e.g. changing rainfall patterns, temperature and wind regimes and more frequent and extreme weather events) are considered to be:

- changes to the timing, magnitude and frequency of water flows
- in fresh water–dominated wetlands, reduced water depth and/or salt water inundation due to sea level rise
- impacts on habitat condition and availability
- changes to species composition, including invasive and naturalising species
- increased erosion and habitat disturbance.

Specific impacts of climate change depend on the circumstances of individual wetlands. For example, for the Macquarie Marshes in NSW, the impact of climate change is described as:

> Under the best estimate for climate in 2030, the average period between important inundation events in the Macquarie Marshes would increase by a further 10 per cent from the current level. The number of flood events would be 5 per cent smaller, and average annual flood volume would be reduced by 16 per cent. The scale of waterbird breeding events is expected to be reduced (DECCW 2010).

4.5.3 Pathways to becoming climate-ready

Given the diversity of Ramsar-listed wetlands in Australia and the variety of management arrangements under which individual wetlands exist, it is not possible to identify specific factors that apply to all situations. Rather, this section highlights factors within the Australian Government's jurisdiction that support development of a climate-ready management framework of wetlands, and the issues that require attention in the development and application of the framework:

- high level of knowledge and enforcement capacity within planning institutions for anticipating and planning for climate change
- ecological character of Ramsar wetlands is a matter of national environmental significance and is protected under the EPBC Act; this provides a basis for setting objectives that incorporate species, ecological processes and benefits and services of the wetland
- although the current degree of specification limits its potential, the national framework for describing the ecological character of the wetland and monitoring LACs provides a good basis for developing adaptive management to accommodate potential future changes under climate change. For example:
    - LACs need not necessarily be fixed thresholds but may be negotiated as a variable marker that reflects and responds to developments in science, knowledge and understanding about the natural variability of species
    - LACs are triggers to investigate possible changes in ecological character, and are often linked to triggers in management plans; they document assumptions and are used for risk assessment, but this is not their purpose.
    - exceeding a LAC does not imply loss of values or Ramsar listing
- key ideas beginning to emerge include:
    - wetland-system changes are likely and in some cases inevitable; e.g. Macquarie Marshes are being re-classified from being 'semi-permanent wetlands' to 'ephemeral wetlands'
    - buffer zones around Ramsar sites are beginning to be protected to enable wetlands to 'creep' and adapt to a changing climatic and physical environment
    - the approach of 'picking winners' (i.e. which wetlands will survive climate change); this may be explicit or implicit in the policies of states and territories.

Challenges that require attention for policy supporting Ramsar sites to become climate-ready:

- the listing process under the original Ramsar Convention was driven more by community-identified values around specific wetlands compared to the listing process for other protected areas. This community-driven process has gradually been supplemented and supplanted by a process that emphasises ecological science and knowledge. Nominated wetlands are now subject to a much more rigorous scientific assessment. This development serves to justify listing based on ecological need and value. While the focus is justifiably on ecological grounds, the process of assessment and nomination must continue to embrace the biodiversity values of the broader community, particularly in recommending particular wetlands for Ramsar listing
- the values that drive the listing process are potentially different from those that underpin the management framework for maintaining the ecological character of the site
- there are no site-specific objectives in the ecological character descriptions; all objectives for a site come de facto from the Ramsar text, and these are not usually translated down to site plans

- the Australian Government has limited constitutional capabilities over the management of Ramsar-listed wetlands on state- and privately owned land. The Australian Government encourages and supports state governments to have and maintain good quality wetland management strategic documents (and sets an example with wetland management and planning on Commonwealth land); it exerts moral suasion by providing program funding (such as Caring for our Country) and where required, intervention using the EPBC Act. The EPBC Act provides a legal framework for the Australian Government to assess actions that could have a significant impact on the ecological character of a Ramsar site
- difficult to determine LAC in Australia because of the large natural variability in Australian wetlands and the lack of monitoring. Monitoring is the responsibility of states, which also have limited resources
- where there is a change in ecological character as a result of climate change, there is no requirement to report to the Ramsar Secretariat or to take corrective action
- as new knowledge and understanding is generated, redefining a LAC is consistently going on in the background of setting a LAC.

Other issues raised:

- how is a 'resilience' threshold for a wetland determined and then reflected as a LAC?
- what does 'healthy' mean in the context of a changing wetland?

4.6 Key issues across all case studies

Each case study represented a variety of different institutional and biophysical contexts within which to consider the challenge of moving towards a climate-ready approach to biodiversity conservation management. The variety of the case studies proved valuable in highlighting different dimensions of the challenges facing biodiversity planning. Nevertheless, a number of regular issues, challenges and problems were observed across all stakeholder grounds and these are discussed in this section. These observations are broadly consistent with those found in the review of biodiversity conservation documents and suggest that they may be both robust and consistent across different conservation and planning contexts across Australia.

4.6.1 Objectives are very hard to articulate in terms of biodiversity outcomes

With some exceptions, participants found it difficult to articulate clear, outcome-focused biodiversity objectives that drove their day-to-day conservation management activity.
The strategic documents they used all had high-level objectives or visions about conserving biodiversity (such as preventing decline). However, the more detailed objectives that might provide guidance to management were typically not phrased in terms of desired biodiversity outcomes or were not specific. In reality, some agencies did use processes that embodied very specific conservation objectives (e.g. maps of spatial priorities resulting from an optimisation process), but these processes were used in implementation phases and not the strategic definition of objectives, and furthermore the embedded objectives were not clearly articulated and were sometimes actually at odds with the stated intent of the programs.

This is an important research finding with implications for adaptation in conservation agencies. Lack of or poorly articulated desired or expected biodiversity outcomes will make it much harder for agency staff working to their plans to readily appreciate the implications of climate change (in particular, how it is very different from other threats), and difficult for them to engage (spontaneously) with the challenge of responding in a complete way.

A key potential reason for this is that frequently the current objective is implicitly to ‘keep biodiversity as it is’, ‘stop all species going extinct’, ‘maintain type and quality of ecosystems’ – objectives that are only likely to be appropriate in a stationary climate. Many participants did not think about objectives or outcomes of biodiversity conservation nearly as often as they thought about the mechanisms of implementation (i.e. the ‘what’, ‘where’ and ‘how’ of management).

From our observations it appeared likely that this was reinforced by two institutional factors. First, the authors of some of the biodiversity conservation documents were not trained as strategic planners and found it difficult to bridge the gap between operational planning (i.e. planning where and how to implement on-ground conservation) and strategic planning (planning what broadscale objectives are to be adopted). Given that NRM may tend to attract people who want to ‘get their hands dirty’, this is not surprising. However, it does explain why it is difficult for staff to articulate the ‘why’ of conservation rather than the ‘what’.

This is exacerbated by the culture of ‘accountability’ within public agencies, which expect all expenditures to be clearly reported against relatively simple and short-term, often input-focused measures of success. On the one hand, this level of accountability is understandable: biodiversity conservation predominately uses publicly sourced funds. On the other, a consequence is a management culture that is averse to risk and the perception (or reality) of ‘policy failure’. As such, biodiversity conservation managers have a strong incentive to focus on and frame objectives in terms of factors that they can control (predominately inputs, over short time frames), rather than on factors beyond their direct control (longer-term outcomes for biodiversity). The result is an input- focused management regime and input-focused objectives driven by short-term funding regimes.

4.6.2 The challenge of describing new concepts with old language

Language used to describe key concepts in biodiversity management plans often has multiple meanings. Climate change adds yet another lens to interpreting the language and the concepts that underpin it. Other ‘filters’ are political, stakeholder/community values and context, risk assessment – all of which were relevant to workshop participants.

The language they used reflected the institutional context of their planning process, including not only the ideas behind planning, but the political and socio-economic context underpinning broader policy imperatives. Different groups showed different sensitivities to particular words and concepts and the ideas they express. For example, for some stakeholder communities ‘climate change’ was considered an inappropriate phrase and the term ‘climate variability’ was used instead. While many strategic documents have glossaries, it was not clear that any group had explicitly examined the implications of ambiguity in key words and phrases used in their planning processes, and sometimes the definitions in the glossaries were at odds with the sentiments we inferred from the text.

If the purpose of this research was to introduce new concepts in biodiversity conservation, then the language needs to reflect these new concepts and be understood by end users as representing them. This is critical. Workshop participants found it difficult at times to distinguish between concepts that use the same language – for example, ‘resilience’ could be meant as either ‘resistance to change’ or ‘enhancing capacity to keep valued functions in place as the system changes’.

Therefore the workshops highlighted a pressing need to find clear ways to explain and easily communicate these new concepts. This could be with new terms (i.e. creating new metaphors, heuristics, mental models that express these concepts), or by re-defining existing words to fit new meanings. While it is tempting to use existing language as a transition path to introduce new concepts, it is recognised that it can also lead to confusion. Different ways of expressing concepts resonate with different people, suggesting that multiple methods for flexibly communicating new concepts are required, including using a range of examples and case studies, and ultimately communicating in a manner that appeal to the broader community base.

4.6.3 The relevance of the core climate-ready concepts to partners

Issues of language and different institutional contexts notwithstanding, it was very clear in each of the workshops that the core adaptation concepts were highly relevant (could have a material impact on planning), and most of the participants were already aware of the issues to some extent; however, in most cases these concepts had not been incorporated into planning to the extent that might be required to address significant climate change.

Multiple values

All participants readily embraced the concept of multiple dimensions of biodiversity, and these were reflected in strategic documents in various ways ('species, ecosystems and landscapes'; 'variety, quality, quantity'). Similarly, participants and documents recognised multiple societal values associated with biodiversity (e.g. 'ecosystem services'), including placing an intrinsic value on biodiversity. It was also broadly accepted that considering multiple values within biodiversity conservation planning was important and that the current suite of planning tools did not adequately incorporate a wide range of values. However, it was also recognised that for some workshop participants it remains a challenge to develop a clear framework for translating multiple values into policy and planning processes. The language in documents and discussion describing the management of different aspects of biodiversity frequently referred back to benefits for species persistence rather than the direct societal values from those aspects. In general in documents and some discussion, the difference between means and ends was not clear.

However, from the photo sessions in the workshops and the discussion that this exercise stimulated between participants, it was overwhelmingly clear that a wide range of different aspects of biodiversity (spanning species, ecosystems and landscapes) were highly valued. The contrast between the language and values reflected in the photo session and the session on documented objectives was marked, highlighting, for this audience at least, that there may be a disconnect between societal values and what conservation programs are currently seeking to protect.

Ecosystem health

Research partners were attracted to the idea and utility of defining the concept of 'ecosystem health' so it is separate from ecosystem types, particularly in the context of maintaining ecosystem health as type changes under climate change. However, it was also recognised that most currently used concepts and measures of ecosystems or ecosystem functions (e.g. vegetation condition, fire regimes, flood regimes) were closely referenced to the type of the ecosystem and historical conditions. It was widely agreed that objective measures of ecosystem properties that could be compared to objective but shifting baselines would be desirable, for example, actual primary productivity compared to climatically determined potential primary productivity.

This area remains a live research agenda for future projects.

Landscape

The concept of landscapes and the social values associated with the mix and relative proportions of land uses, degrees of naturalness, view-scapes, wilderness, and so on were extremely well recognised in the workshops. These were frequently represented as values in introductions to the regions provided by partners in the workshops, in the introductory text of their strategic documents, and in the photo sessions. However, it was also appreciated that values associated with landscapes were very poorly represented or were absent in objectives and actions of their biodiversity conservation documents and from the broader institutional context within which they operated. Clear language and concepts to articulate these issues was a challenge.

Static versus dynamic objectives

The concept of managing to accommodate the dynamics of biodiversity was well embedded in plans and thinking for the case study partners (e.g. Limits of Acceptable Change for wetlands). However, this almost always referred to variation within presumed fixed bounds associated with the current state of biodiversity. There was little recognition in documents of the likelihood of large-scale changes in biodiversity (changes in state) under a changing climate and the associated shift in the acceptable 'natural variation'.

In discussions, the core concept of developing objectives that accommodated such changes in biodiversity – climate-ready objectives instead of the current static objectives – was well received by participants in the workshops and was reasonably well understood at a theoretical level. However, the implications for strategies and priorities of setting climate-ready objectives for conservation were less well understood and only readily embraced by a small proportion of participants. For example, participants expressed surprise and concern at the additional work and difficultly associated with identifying and articulating properties of biodiversity that may persist under climate change, those attributes that will be 'let go', and the process for encoding these decisions into strategic and management objectives. There was often significant resistance from some participants to the idea that anything could be let go. These discussions highlighted the key challenge of developing a framework and conceptual model for translating these theoretical future-oriented concepts into actual language of objectives and everyday management.

Uncertainty

Uncertainty was readily understood as a key challenge to becoming climate-ready, but implications for planning and approaches to managing uncertainty were either not well articulated or relied on the resilience or adaptive management approaches. The resilience approach generally took the form of accommodating variation, and adaptive management focused on monitoring, then managing when needed. It was interesting to observe that those partners who had a history of using resilience frameworks readily appreciated the critical conceptual difference between resilience of a system as it changes and resilience against climate change (resistance), and they readily recognised the limitation of the concept as a solution to climate change. Only a small number of participants appreciated the depth of the practical and institutional implications for the design and implementation of conservation programs arising from pervasive uncertainty about future states, rates of change and values.

4.6.4 Institutional context affects how people engage with new concepts about biodiversity

Almost all of the workshop participants expressed a need within their agencies to adapt their planning and activities in response to the future impacts of climate change. However, there was significant variation in the readiness of stakeholders, and critically their agencies, in their capacity to embrace the various adaptation concepts and their implications for planning and management.

This appeared to be partly due to the nature of the institutional structure in each agency, and the progress of their planning cycle, which together influenced their near-term opportunities to incorporate new concepts into planning and management objectives. For example, several workshop participants were in the process of revising their strategies, and volunteered how they would directly adjust planning in response to one or more of the concepts, whereas others were more focused on implementing existing plans. Some concepts were harder to put into action due to lack of understanding about how to operationalise them (e.g. the idea of ecosystem health independent of type).

In the longer term, institutional structures and institutional culture also shape the transition towards plans becoming climate-ready. Four issues in particular stood out from the discussions:

- Many planning processes do not independently operate with sufficient freedom to select, design and express their own objectives, but are placed within a context that requires them to refer to some broader objective setting process. This institutional nesting may or may not become a barrier to developing climate-ready objectives.
- A culture of strict accountability is, while understandable, creating a culture whereby the focus is on achieving inputs into biodiversity conservation, rather than outcomes, because for the former it is easier to show that performance measures have been met.
- A culture of strict accountability and risk aversion makes it difficult to look at adaptation strategies that are experimental in nature or are subject to other uncertain factors and have a risk of failure.
- Individuals vary in their ability to engage with key climate-ready concepts.

This suggests that finding a context-specific entry point into the broader institutional framework of biodiversity conservation is critical. An ideal entry point would be some type of institutional leverage (person, process or group) that has the capacity to understand, absorb, adapt and implement climate-ready principles within the decision-making process and also has the institutional influence to drive acceptance of the climate-ready approach. It had been the assumption of this project that desired ecological outcomes (codified in conservation objectives) would be an effective entry point, enabling ready self-discovery of vulnerability and adaption need. The new Australian Government ‘Regional NRM Planning for Climate Change Fund’ (SEWPaC 2013) is an external institutional driver that may help enable engagement with the climate-ready approach.

4.6.5 Problems with the threatened species approach well recognised

Although threatened species communities featured in all documents used by the workshop participants, there was some, although not universal, recognition that dominant focus on threatened species, either as an end in its own right or as a tool, was decreasingly useful as a decision-making framework. For example, groans of despair accompanied discussions of particular iconic threatened species in two meetings with regional biodiversity managers. This observation came from a recognition that the threatened species ‘problem’ will only to continue to increase with the increasing number of threatened species over time and will ultimately overwhelm planning infrastructure, resources and capacity, though participants did remain very concerned about individual threatened species and communities.

In questioning a focus on threatened species there was typically poor differentiation between conserving threatened species per se, using them as a surrogate for conserving additional elements of biodiversity or using them as a metaphor for biodiversity conservation as a whole.

As an alternative to threatened species there was some focus on landscapes and ecological processes, although these ideas were not conceptually well developed, and prioritising where or why these might be managed often fell back to assessing the ecological requirements for supporting species or focusing on highly cleared ecological communities.

That said, threatened species will likely form an important part of conservation planning in the near to mid-term future because:

- as pointed out by CMA partners, threatened species can act as a useful icons (e.g. koalas) to get the local community involved in on-ground conservation work – people may get involved because of particular beloved species, but generally stay for broader biodiversity conservation issues
- some species play particular and important functions in ecosystems as 'keystone species' or 'ecosystem engineers' (e.g. cassowaries in the Wet Tropics rainforests)
- threatened species frameworks are required to be implemented by CMAs by state planning authorities
- they remain the dominant metaphor for biodiversity decline and conservation; threatened species are the language of conservation, even if the meaning is ambiguous and fluid
- the general response to these drivers was an acceptance of the status quo with an acknowledgement that on-ground planners will need to 'work around' the limits of the threatened species approach
- many core national and state biodiversity conservation institutions are based on threatened species and there is no readily available and sufficiently mature ecological concept that could be used as an alternative.

4.6.6 Concern about perverse outcomes

Many stakeholders were concerned with the risk of perverse outcomes and mal-adaptations as a result of poor planning for climate change, and in particular the risk of creating a worse biodiversity outcome as a result of a well-intentioned but narrowly framed management intervention (called 'bio-perversity', Lindenmayer et al. 2012). Indeed, it was recognised that one of the most significant near-term consequences of recalibrating conservation objectives might be to avoid actions that might currently seem adaptive but that might not be efficient investments in the long term, such as identifying and prioritising the most vulnerable species.

5. OPERATIONALISING THE ADAPTATION CRITERIA: A TOOL TO HELP NATURAL RESOURCE MANAGERS DEVELOP CLIMATE-READY BIODIVERSITY CONSERVATION OBJECTIVES

5.1 Introduction

This chapter describes a prototype tool for assisting natural resource managers operationalise the climate-ready adaptation criteria developed in this project. The review and case study phases of the project suggested the adaptation criteria are potentially powerful heuristics for gaining insights into the challenges of managing biodiversity under climate change. However, moving from the concepts of the climate-ready approach to practical conservation objectives in management plans is likely to be challenging without the aid of a process or tool. We explored a range of approaches to this task, including a diagnostic tool, a scenario process and a guiding questions process. Different approaches may be more suitable in different institutional contexts. Drawing on previous experience, we chose to focus initially on a guiding questions process that could be readily used in regional NRM planning to help develop climate-ready conservation objectives (the 'tool'); the other two approaches may be developed in the future.

The aim of the tool was to develop a process to assist NRM managers explore the implications of the climate-ready adaptation criteria within their planning and geographic context in a manner that minimises the need to understand the abstract concepts. Insights gained from exploration of the concepts can then be used to inform the development of climate-ready objectives and to inform implementation and adaptation processes. The tool is a device to think about objectives in a climate-ready way. It is not a planning process per se, but it could be a useful part of a broader planning process. The tool could also be used to assess current objectives and scope new ones to help build understanding of climate adaptation and the capacity to incorporate a climate-ready approach into planning when the opportunity arises.

The effectiveness of relatively simple tools and heuristics to support learning and adoption of new concepts has been well documented (Newell 2012). Our experience in the case studies suggests that gaining an understanding of the climate-ready concepts can increase the capacity of planners and managers to scope the challenge of addressing the future impacts of climate change. We envisage this tool being used by natural resource managers and planners at the regional scale, although it could be useful at any scale to explore the relevance of the adaptation criteria for NRM and conservation policy and planning processes. The tool could be used in the context of a larger strategic planning process, for example, in the development or review of a catchment management plan, or forming one step in the development of new climate-ready biodiversity conservation objectives and strategies.

The tool outlined below is a prototype. It has had limited testing with conservation decision-makers, although the climate-ready criteria, some of the prompting questions and the tables have been used throughout the case studies with conservation and NRM agencies.

Use of the tool could be supported with a range of supplementary material that would need to be developed before the tool could be disseminated, including a primer on the impacts of climate change, an explanatory presentation, a number of examples and diagrams to illustrate concepts and pro-formas to aid recording relevant information.

5.2 Principles for guiding the development of the tool

In developing the tool to support planners and managers develop climate-ready conservation objectives, we recognise the challenge faced by those responsible for developing NRM plans. For the most part, NRM planners are usually *not* qualified planners, nor experts in climate change, although many NRM planners have strong technical and on-ground management backgrounds. Any tool developed to support biodiversity planning must be sensitive to this context. Our approach to developing the tool has been informed by the principles that it should:

- support learning and capacity building
- be flexible to the different contexts in which the tool may be used
- draw on the range of knowledge types, including scientific, management and local knowledge, rather than be solely expert- or data-driven
- use clear and simple language where possible.

We anticipate the outcomes for planners from using the tool will include:

- increased capacity to develop climate-ready outcome-focused biodiversity objectives
- increased capacity to understand some of the consequences for policy, planning and management of the ecological impacts of climate change
- increased capacity to describe the range of different dimensions of biodiversity in appropriate language
- better incorporation of the multiple ways biodiversity is experienced and valued by society
- an ability to anticipate a wider range of change trajectories
- increased capacity to acquire information about possible future climate and ecological change.

This tool is designed to assist planners and managers who may be reviewing current conservation objectives for their climate readiness or in the development of new objectives. In either case, the tool is designed to consider:

- how specific attributes of biodiversity may change under current and future climate change
- uncertainty in the way climate change will affect species and ecosystems
- what aspects of biodiversity should be actively managed under climate change
- the broad range of ways in which the community values biodiversity.

5.3 How to use this tool

This tool is designed as a series of questions (largely yes/no) arranged in a flow chart. Each node in the flow chart is accompanied by an explanation of the key question and the issues that managers should consider at that stage of the process. Some prototype climate-ready objectives and the discussion of issues associated with implementing them are included in Appendix 2.

It is anticipated each pass through steps 3–12 of the flow chart will lead to a single climate-ready objective, and that multiple passes will be used to develop a suitable set of climate-ready objectives reflecting the full range of values that their community may hold for biodiversity.

The tool is designed to help managers explore the challenge of adapting conservation objectives and strategies so they accommodate significant levels of climate change. It is assumed that people using the tool will have a working understanding of climate change and the possible impacts on species and ecosystems in their region. However, it is recognised that the concepts behind the climate-ready approach are sometimes difficult to fully understand, therefore it is anticipated that use of the tool will be facilitated by an expert familiar with the concepts, if not the local context.

In using this tool, managers will note that:

- if the answers to questions lead them to an oval shape node, then it is likely that the objective is 'static' or not consistent with the climate-ready criteria
- if answers to questions lead to a rectangular node, then it is likely the objective is consistent with the climate-ready criteria.
- the tool recognises that some static objectives may be valuable in the short run in order to address other threats or respond to community demands. Ideally, these types of objectives should be considered as temporary, have explicit timeframes associated with them and be relatively few in number compared to a larger number of climate-ready objectives. These objectives are denoted by red ovals.

Using the tool effectively requires basic information about climate change, biodiversity, community values, statutory obligations and other policy context relating to biodiversity. Specifically, information to support the discussion around the guiding questions should include:

- a good understanding of the various aspects of biodiversity in the region that are experienced and valued by stakeholders at different scales. This could include information from value-mapping exercises, interviews and surveys or other sources such as existing plans, and should consider different attributes of species, ecosystems and landscapes of the region.
- climate change information and scenarios for the relevant region; in particular, information of worst-case scenarios for anticipated changes in temperature, rainfall and evaporation will provide the users with a snapshot of potential climate changes with the greatest impacts on biodiversity
- any information about species distributions and habitat associations, ecosystem type and extent, land uses, levels of habitat protection, and landscape 'patterns' (including habitat connectivity and configuration); other pressures (threats) that may influence biodiversity are useful but not essential to the discussion
- information about the impacts of climate change on species, ecosystems and landscapes in the region
- knowledge about the statutory requirements and other policies and obligations relating to biodiversity protection that may be relevant to the discussion.

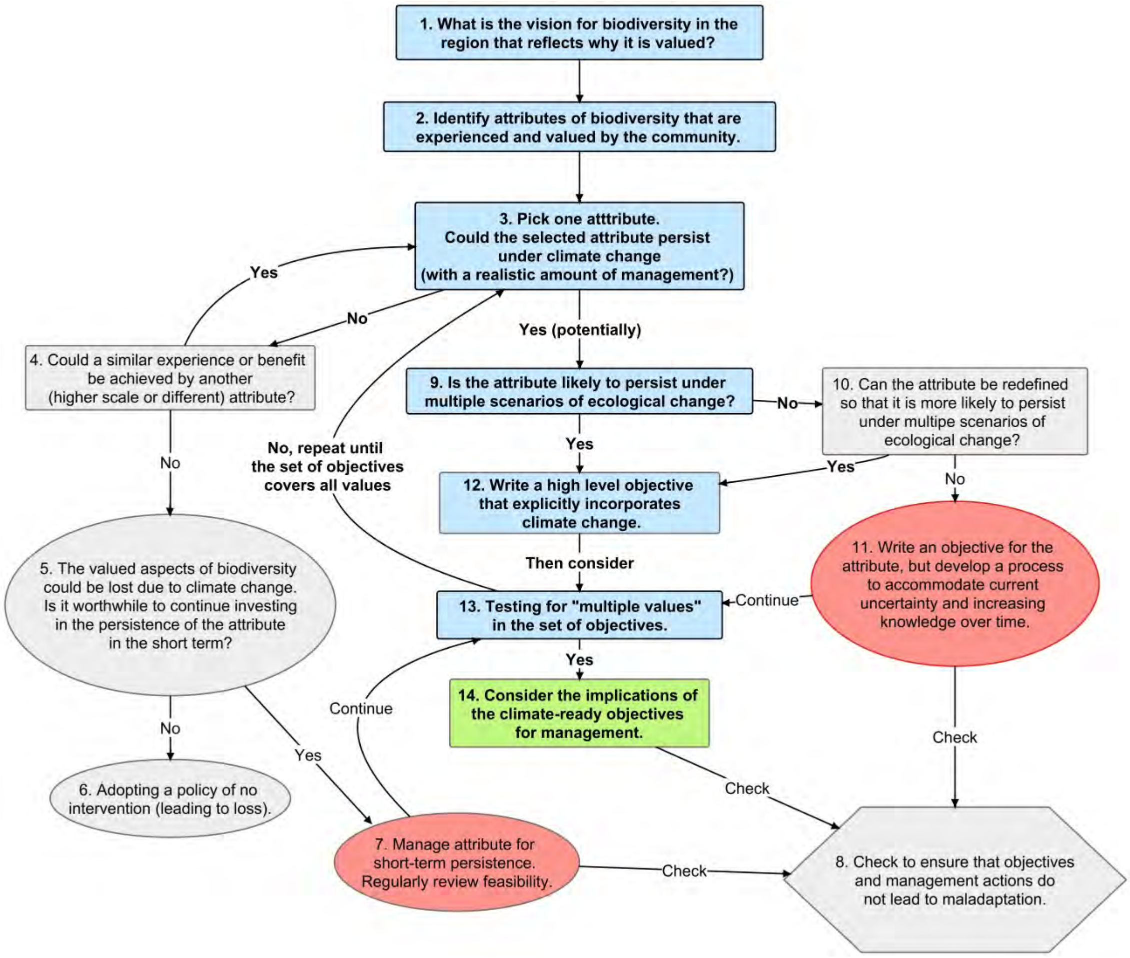


Figure 8: The guiding questions tool for helping develop climate-ready conservation objectives

5.4 Key tasks in the tool

This section outlines the questions and issues that are addressed at each node of the tool. The key question for each node is in the shaded box, followed by a brief statement of the issue, and some discussion or examples. The key action for the node is highlighted in italic text. The sequence through the nodes is dictated by the responses to the questions in the shaded boxes, as indicted in the flow chart. Where a climate-ready approach has already been embedded into planning, the user can expect to cycle through the blue shaded rectangles, and end up at the green rectangle (node 14) with a complete set of climate ready-objectives. The two grey rectangles (nodes 4 and 10) indicate where a selected attribute might not be consistent with a climate-ready criterion, and the user has a choice to revise the attribute and continue on the climate-ready pathway, or to develop a non–climate-ready objective that may be effective in the near term (red oval nodes 7 and 11). The hexagon (node 8) is a check that the non–climate-ready objectives and indeed possible management arising from the climate-ready objectives do not lead to management actions that might inhibit longer-term implementation of the climate-ready approach.

1. What is the vision for biodiversity in the region that reflects why it is valued?

An overall vision for the NRM or biodiversity in the region is likely to be a useful starting point for developing climate-ready objectives. A suitable vision would be a high-level statement about the aspirations for biodiversity and how it is experienced and valued by people in the region.

Examples of these vision statements are:

> Healthy landscapes and seascapes managed to be sustainable, resilient and productive by viable industries and vibrant local communities.
>
> *Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*

> The vision of this Strategy is that Australia's biodiversity is healthy and resilient to threats, and valued both in its own right and for its essential contribution to our existence.
>
> *Australia's Biodiversity Conservation Strategy 2010–2030*

> The people of South Australia actively supporting their native plants, animals and ecosystems to survive, evolve and adapt to environmental change.
>
> *No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*

These examples all emphasise the ecological and social dimensions to biodiversity.

- Sustainable landscapes and seascapes (*Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*)
- Sustainable utilisation of resources (*Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)* and *Australia's Biodiversity Conservation Strategy 2010–2030*), presumably for land-based production
- Existence of biodiversity for its own sake in the face of ongoing change (*No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017* and *Australia's Biodiversity Conservation Strategy 2010–2030*).
- Valuing specific instances of plants, animals and ecosystems found in a particular location (*No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017*)
- Engagement of the community with biodiversity (*Draft Northern Rivers Catchment Action Plan 2012–2023 (CAP2)*).

These examples highlight that biodiversity is experienced and valued in a multitude of ways. It may be useful to think explicitly about how different aspects of species, ecosystems and landscapes in the region are valued by society and contribute to its wellbeing.

Write a vision statement for your objectives. A starting point may be to look at the existing strategic documents and plans for biodiversity management.

2. Identify attributes of biodiversity that are experienced and valued by the community

The way in which the community values biodiversity is often associated with a physical characteristic or attribute of biodiversity. People can value specific biota or places due to a wide range of attributes associated with each:

- People may value the ABUNDANCE of white-faced herons at a local wetland or they may value the DIVERSITY of water birds found there.
- Iconic species may be valued for their EXISTENCE, for example, the waratah flower is valued because it is emblematic of Australia's flora and is the state flower of NSW.
- People may value a particular nature reserve because it allows them to experience PROXIMITY to nature, gives them RECREATIONAL opportunities and provides VISUAL AMMENITIES for the community.
- A natural area may also be valued because it helps MAINTAIN ENVIRONMENTAL SERVICES such as water quality in a rural catchment.
- People may value a landscape or location because it provides a SENSE OF PLACE or belonging.

These instances describe *why* the community may value something. Abundance, diversity and existence are all specific instances of valuing biota, while proximity, recreation, visual amenity, maintenance of environmental services and sense of place are all specific instances of valuing a place. The distinction between valuing specific biota and valuing the changing biodiversity of a place is an important part of the climate-ready approach.

In addition, the attributes of biodiversity valued by the community may relate to very specific aspects of biodiversity, or they relate to more general aspects of biodiversity. Examples of attributes associated with specific aspects of biodiversity are:

- valuing a specific species of bird, mammal or plant (e.g. a magpie)
- valuing the amenity of a specific type of vegetation (e.g. alpine ash forests)

Examples of attributes associated with more general aspects of biodiversity are:

- valuing the abundance and diversity of bird species at a wetland
- valuing the visual amenity and recreational opportunities associated with healthy native bush in close proximity to a community.

List all the different attributes of biodiversity (including species, ecosystems and landscapes) that the community experiences and values in the region. These may relate to how biodiversity is used, or simply the fact that it exists. Are these experiences and values reflected in the vision statement of the management plan? If not, can the vision statement be re-drafted to better encompass them?

3. Pick one attribute. Could the selected attribute persist under climate change (with a realistic amount of management)?

Climate change is likely to affect biodiversity in many different ways in all regions of Australia. It is now clear that species, ecosystems and landscapes are very sensitive to anticipated levels of climate change, and this is likely to have a significant impact on the way biodiversity is experienced and valued by the community.

In the question above, a list was developed of the attributes associated with the values and experiences of biodiversity. Consider how each listed attribute might be affected as biodiversity responds to climate change. For each attribute, could it be expected to persist or change?

Examples of changes in attributes of biodiversity include:

- a change in the species found in a particular place
- a significant reduction in the abundance of a valued species
- changes in the type of ecosystem found in a particular location
- change in area of natural ecosystems and ecosystems managed for other uses (e.g. crops and pasture) in the landscape.

Note: management has to be realistic and viable in the long run. In theory, many attributes of biodiversity could be managed to persist under very high levels of change with commensurably intensive and expensive management, for example, active gardening of particular plant species and husbandry of animal populations in a quasi zoo. However, in reality, not all management is feasible or affordable in the longer run. One way of determining this is to consider if management costs will increase over time as efforts are made to preserve the attributes. If so, then long-term management may not be viable.

If maintaining a particular attribute is likely to be beyond the current resources or capacity of the management agency, how likely is it to persist under climate change?

4. Could a similar experience or benefit be achieved by another (different or higher order) attribute?

If the attribute identified in the previous question is likely to experience substantial change over a range of climate change scenarios, it may be the case that it is no longer able to deliver the experiences that the community values. For example, a significant change in the abundance or diversity of bird species in a wetland will change the experience (and potential value) to birdwatchers.

In instances where the attribute is no longer able to provide the same experience or value, is it possible that another attribute of the biota or place is able to provide the same or similar experiences and/or values?

This new attribute could be a totally new attribute or, more likely, be expressed as a more general characterisation or 'higher order' description of the original. For example, the original attribute could be abundance of blue-billed duck at a wetland valued because of its existence and for the recreational opportunities for birdwatchers. A higher order characterisation of this attribute could be abundance of duck species regularly using the wetland. This raises the question of whether bird watchers experience and enjoy the same values if they are able to see different species.

Another example may be the existence of a sub-tropical rainforest ecosystem in a specific location. A higher order attribute might be the existence of a forest ecosystem. A different attribute might be the maintenance of a healthy natural ecosystem. This raises the question of the extent to which the value to society of the biodiversity at a location is affected if the ecosystem changes type or condition.

5. This box indicates that the valued aspects of biodiversity could be lost due to climate change. Is it worthwhile continuing to invest in the persistence of the attribute in the short term?

In many situations, some aspects of biodiversity will eventually be lost from a region. Sometimes this will result in loss of value experienced by the community; other times the values might not be affected or might be experienced by different aspects of biodiversity.

Where eventual loss is inevitable or highly likely, is it worth continuing to actively manage this attribute in the short term in the face of other threats? In assessing this situation, managers have the option of withdrawing resources and re-directing them elsewhere (i.e. a policy of 'no intervention') or engaging in short-term strategies (see below).

6. Adopting a policy of 'no intervention' (leading to loss)

Explicitly adopting a policy of 'no intervention' leading to a loss of biodiversity as biodiversity responds to climate change is likely to be a challenge to many members of the community. However, if it is accepted that a realistic amount of management intervention will ultimately be ineffective in assisting the desired attribute to adapt to climate change, then this may be the most prudent course of action.

No conservation objective is needed for such attributes.

7. Manage attribute for short-term persistence. Regularly review feasibility.

Even if an attribute may be lost over a longer time frame, there may be instances where it can continue to deliver experiences and values to the community in the near term, and it is considered worthwhile to continue actively managing it until climate change becomes overwhelming.

This approach may be particularly difficult when the impacts of climate change are similar to and combine with those of other threats, for example, the impacts on a wetland of reduced rainfall combined with water extractions. Should water extraction be reduced to temporarily prolong the life of the wetland, or is increased extraction allowable as the wetland is destined to become drier? These questions have no easy answers.

In addition, a process will need to be developed to determine when to stop actively managing the biodiversity attribute. Relevant questions to consider include:

- Is management being effective in the short run?
- Are management costs likely to increase over time (beyond what is feasible)?
- Is there a critical threshold beyond which substantial and irreversible change to the attribute occurs?

Note: It is anticipated that relatively few objectives will be developed for attributes in this part of the flow chart. If a large number end up here, then a re-evaluation of previous answers to questions may be required.

Should the biodiversity attribute be managed over the short term? What processes will be put in place to regularly review the feasibility of its ongoing management? What criteria and information is needed to determine when to stop managing the attribute?

8. Check to ensure that objectives and management actions do not lead to maladaptation

Maladaptation occurs when actions to avoid impacts of climate change in one domain reduce the options or capacity of this or other domains to adapt in the future. This could occur through development of path-dependent solutions, investing in actions with a high opportunity cost or actions that inadvertently introduce new constraints on other domains. For example, investing large amounts of resources to manage a few threatened species in specific locations may reduce resources available for investing in broadscale actions to maintain ecosystem health or protect habitat for a diversity of species. Another example of maladaptation could be increasing landscape connectivity, allowing pest species to colonise previously inaccessible habitat.

Could implementation of the objectives reduce the capacity of other attributes of biodiversity or other domains to adapt to climate change?

9. Is the attribute likely to persist under multiple ecological change scenarios?

While there is high confidence that species and ecosystems are very sensitive to anticipated levels of climate change, there are many uncertainties about the details of the trajectories of future biodiversity change. One approach for dealing with the wide range of uncertainties is to focus on developing objectives for those attributes of biodiversity that are more likely to potentially persist across a range of different scenarios of ecological change. This is a form of 'robust' management.

For example, if managing for an abundance of grebes in a wetland is likely to be successful over a small set of climate change scenarios, but managing for an abundance and diversity of any wetland birds is likely to be successful over a large number of scenarios, then the latter objective is likely to be a more robust objective.

Could selected attributes of biodiversity persist, with or without management, under a range of possible ecological change scenarios?

Answering this question will require a reasonable appreciation of the different types of impacts of climate change on species, ecosystems and landscapes (e.g. Table 1). As this knowledge is likely to be limited at the regional scale, this question will need to be revisited as new information becomes available.

10. Can the attribute be redefined so that it is more likely to persist under multiple scenarios of ecological change?

If the assessment reveals that the attribute is unlikely to persist across a range of scenarios of ecological change driven by climate change, then management of that attribute will be more complicated. In these cases, there is an increased risk that for some climate change futures, any management effort will be ineffective.

One way to address this risk is to choose an alternative attribute that is more likely to potentially persist under a broad range of scenarios. As in step 4, this could be a different attribute or, more likely, a more generalised or 'higher order' version of the original attribute. For example, the original attribute could be abundance of little terns at coastal wetlands; a higher order characterisation of this attribute could be the abundance and diversity of waders regularly using the wetland.

Is it possible to find another attribute that can deliver similar values to the community and is likely to persist under a range of ecological change scenarios?

11. Write an objective for the attribute, but develop a process to accommodate current uncertainty and increasing knowledge over time

If it is determined that a more robust attribute cannot replace a less robust one, then ongoing management of this attribute will need to include processes that accommodate uncertainty, such as adapting management as new information about change becomes available, or spreading risks.

Write an objective for the attribute that is explicitly linked to processes that actively incorporate new information and knowledge over time. What processes will be put in place to regularly review the feasibility of its ongoing management? What criteria and information are needed to determine when to stop managing the attribute?

Note: Ideally, there are relatively few attributes that fall under this category – most management effort should be directed towards objectives and actions that are robust across a range of scenarios. If a relatively large number of attributes are in this box, then it may be necessary to re-evaluate the previous answers.

12. Writing a high-level objective that explicitly incorporates climate change

If the attribute is able to persist, with or without a realistic amount of management under future climate change scenarios, then the maintenance of this attribute should now become the focus of the objective. More specifically, the objective for managing this attribute should be on ensuring its persistence, while other attributes change around it. This ensures that the focus of management explicitly differentiates between what attributes are actively managed (and maintained) and what attributes of biodiversity are allowed to change under the influence of a changing climate.

A useful syntax for writing such an objective may be:

Objective: Preserve property B, as X,Y,Z properties of biodiversity change.

Some examples of using this syntax are:

Objective A: Preserve the abundance and diversity of wetland bird species, as the composition of birds found at the wetland changes over time.

Objective B: Maintain the current area of native vegetation, as the ecosystem types and species found in these areas change due to climate change.

Objective C: Maintain appropriate levels of key ecosystem functions at a location, as the ecosystem type changes over time.

Prototype objectives for species, ecosystem and landscape dimensions are presented and discussed in Appendix 2.

Write an objective for the attribute using this syntax.

13. Testing for 'multiple values' in the set of objectives

It is anticipated that steps 3–12 of this tool will be used to assess and develop objectives for individual valued attributes of biodiversity. These steps can now be repeated until a set of objectives has been developed that covers the full range of ways that biodiversity in the region is experienced and valued by society.

Objectives that are developed using this tool are now consistent with the two concepts that contribute to the 'dynamic conceptualisation of conservation' (Figure 4): accommodating significant climate-induced ecological change, and accommodating significant uncertainty in the detail of ecological change. For a set of objectives to be climate-ready, they must also incorporate the multiple ways biodiversity is experienced and valued by society.

Taken as a set, do the objectives developed so far reflect the full range of experiences and values the community holds for biodiversity? Do the objectives cover the different attributes of species, ecosystems and landscapes that are experienced and valued?

Once this step is complete it may be useful to start considering the implications of choosing this set of objectives for planning management. In particular, this may reveal where actions are required to manage for outcomes that had not previously been considered, and critically it may reveal where current management may be stopped due to dropping or changing an objective. It may become desirable to iteratively revisit the objective-setting steps as the implications for management are explored.

14. Consider implications of the climate-ready objectives for management

Considering the implications of the climate-ready objectives for biodiversity management provides a link to the management planning process, but also provides a further opportunity for decision-makers to explore and understand the depth of the implications of the climate-ready approach.

One way to do this might be to consider the ecological requirements for the persistence of each attribute in the objectives. This should also take account of the changes in biodiversity that have been explicitly included in the objective.

For example, if the objective is to maintain viable populations of a diversity of bird species, as the actual species present change, the requirements might be a large area containing a diversity of native vegetation as habitat, with minimal other threats (predators), and perhaps some landscape connectivity to facilitate new species colonising over time. The requirements could also include some parameters of disturbance regimes. Are the ecological requirements of the attribute in the objectives known?

Some of these ecological requirements may need little direct management; for example, sufficient area of habitat may already be protected from clearing and degradation. Some may need continuing management (e.g. controlling pest animals), and some may need new management (e.g. ensuring connectivity in the broader landscape).

Critically, there may be some aspects of management that change. For example, if the area is currently home to species that require a particular type of habitat, then past management may have included maintaining or restoring that specific habitat type. However, if the new objective allows for change in the species assemblage, then no specific habitat type is prescribed; this suggests no management seeking specific habitat types is required. However, some properties of habitat – such as a diversity of structure and diversity of habitat types – might be the subject of management.

Similarly, an objective may change from 'maintain a specific type of wetland' at a location, to 'maintain the health of the wetland as the flow regime dries'. This may lead to stopping the active diversion of water into the wetland as the catchment dries, and allowing the wetland to naturally change, which may require no active management.

The climate-ready character of the objectives can be carried through into management planning by explicitly including, in management statements, descriptions of the expected or acceptable ecological change using the syntax:

> Maintain the [desired attribute] by managing the [specified ecological requirement], as [other specified attributes] of the species, ecosystem or landscape change.

For example

> Maintain a diversity of bird species by protecting a large area of diverse habitat, as populations of individual species come and go and the type of ecosystem changes.

Other relevant questions about managing the ecological requirements could include:

- For the attribute to persist, is active management required for the purposes of adapting to climate-induced change?
- Is that management feasible?
- Will it continue to be feasible in the long term?
- Are there unknown factors affecting its implementation or desirability?
- What information might be needed to guide implementation now or in the future?
- Is that information feasible to collect?

6. CONCLUSIONS AND FURTHER WORK

This project was motivated by concerns that current conservation strategies might not be effective when confronted with significant ecological changes that would result from anticipated levels of climate change. Drawing on a synthesis of knowledge about future ecological change, the project developed a framework around three propositions about the effectiveness of conservation strategies in the face of significant levels of ecological changes. The framework can be used for exploring the effectiveness of and for developing new climate-ready conservation objectives. The framework highlights how 'objectives' – biodiversity outcomes valued by society – are a critical entry point to ensure conservation strategies and plans are framed in a manner that ensures they can be effective under climate change: the framework can be used to develop climate-ready objectives in policymaking or planning, or as a process to build the capacity of individuals and agencies to understand the challenge of responding to future climate change. Using the framework, the project reviewed and assessed a broad sample of current (and draft) conservation strategies, conventions, legislation, action plans and so on that span international, national, state and regional scales.

The framework was also used in four case studies with national, state and regional conservation planning agencies, and a selection of their partners, to examine their current strategies and objectives, the diverse ways biodiversity is valued in their areas of interest, the implications of climate change for the current strategies, and issues associated with adapting their planning to effectively address climate change. These review and case studies enabled us to explore the existing objectives and strategies and test them against our three core adaptation criteria, but also validate and refine the criteria and how they might be presented and used.

Revising conservation objectives is a substantial mission affecting well-established, complex institutions in a contested policy space. It has significant scientific, social and public-policy disciplinary challenges as well as being fundamentally transdisciplinary in nature. This project set out to test the proposition that current objectives are not well suited for addressing future challenges of climate change, to scope some of the issues involved in revising objectives, and to provide knowledge and insight to build the capacity of conservation planners and researchers in Australia. As well as some clear findings, the project has clarified various next steps and research directions, most of which span multiple academic disciplines.

To ensure the conceptual development and research findings can readily be used in real world conservation planning, the project also developed a prototype tool for helping NRM planners test their current objectives and prepare and develop new objectives that might be more effective under climate change. The concepts and challenges are also illustrated in the prototype objectives in Appendix 2.

Below we outline the key findings and future directions for research and policy development.

6.1 Current objectives

6.1.1 Climate readiness of current objectives

This research clearly found that the level of climate readiness was low among existing conservation strategies in our representative sample. However, within the sample there were some objectives and some whole strategies that could be expected to be effective under climate change. From our sample and consultations, we conclude that conservation planning in Australian is strongly embedded in a 'static paradigm', focusing on preventing loss, managing small amounts of ecological change and stationary benchmarks, and where threatened species work as proxy for other values. There is variation within this paradigm, with much innovation in various agencies and individuals, and new more-dynamic concepts being developed, but much of the constraint comes from the legacy of existing practice and from institutional factors such as the concepts embedded in legislation which flow through nested structures to individual strategic documents and management plans.

6.1.2 Not biodiversity-outcomes focused

A large proportion of the documents we reviewed were well designed to conserve biodiversity, but the framing of their objectives did not provided clear descriptions of the desired outcomes for biodiversity. In some cases these could be inferred from details about implementation or from supporting text. Where biodiversity outcomes were explicit or could be inferred, they were typically either not consistent with the climate-ready criteria, or not specific enough to provide guidance about the intentions of the strategy for biodiversity, especially with regard to the various distinctions between different attributes of biodiversity we regarded as essential for being climate-ready.

6.1.3 Use of related concepts

There was very widespread use, throughout the documents we reviewed and in the discussions with representatives from agencies, of concepts closely related to our three core adaptation criteria. However, in the majority of cases the manner in which the concepts were used was still clearly insufficient to be judged as climate-ready (for example, accommodating climate variation but still under the assumption of a stationary mean climate). Yet it shows there is a very good basis from which to develop the concepts, and the capacity in agencies to develop climate-ready objectives.

6.1.4 Need for a new narrative

An overarching message from the reviews and discussions was the need for the conservation community of practice to develop a new narrative about biodiversity and its conservation under rapid climate change. So many aspects of Australia's current conservation system reflect the static paradigm that a new narrative is required to motivate reassessments of the direction of conservation strategies and the science that supports them. Ecosystem services and resilience thinking are examples of new narratives that have shifted conservation thinking to some extent; we suggest, however, that these concepts are necessary but insufficient components of a truly climate-ready narrative.

Central to developing a new narrative is an ongoing discussion with people who have a stake in the future of biodiversity under climate change. This needs to be informed by relevant concepts and technical information, but most of all by exploration of the variety of societal values associated with biodiversity.

To be successful, the new narrative must not only capture the essence of managing biodiversity under climate change (e.g. pass our climate-ready criteria), but must also clearly be distinct from and inconsistent with the static elements of the current paradigm.

6.1.5 High relevance of the climate-ready criteria

The project found that the three core concepts were highly relevant. In all the strategic documents and case studies, related concepts were being used or it was clear that application of the concepts could readily lead to significant changes in objectives, management priorities and biodiversity outcomes. This was an important validation of the preliminary proof-of-concept developed in previous projects.

6.2 *'Climate-ready conceptualisation' of conservation*

Central to this project was the development of three propositions about adapting to climate change. They arose directly from three conclusions about what is known about how climate change will affect species, ecosystems and landscapes; we translated them into criteria for assessing existing or new objectives. Collectively, they form the climate-ready conceptualisation of conservation: distinguishing between large ecological change and losses to be minimised; accommodating uncertainty in future change trajectories; and conserving multiple dimensions of biodiversity that give rise to value.

6.2.1 *Concepts are robust, but challenging*

The project found that the three concepts were relevant and robust. It was easy to discuss related concepts within the current static paradigm. However, when pushing the application of the concepts beyond the static paradigm to accommodate changes in the state of biodiversity, the need for new types of benchmarks, the breakdown of existing established management proxies and so on, it became much more challenging for many of the workshop participants. The challenges arose both at conceptual and personal levels: it is hard to imagine the ecological changes that the science indicates are possible. Those changes, and the implications of them for conservation, are outside the experience of the decision-makers, and they sometimes challenge hard-won established positions and personal values.

6.2.2 *'Words are empty vessels until filled with meaning'*

Ambiguity in language was an issue throughout the project. We encountered it in our reviewing and assessing strategic documents, and much time was spent in the workshops unpacking the intended meanings of words that are used every day in biodiversity conservation, such as 'biodiversity', 'conservation', 'ecosystems' and 'landscapes'. In the static paradigm the meanings of many terms are less critical, but to adopt the climate-ready conceptualisation it becomes necessary to be clear about subtle differences in concepts, and also unpack very different concepts (e.g. 'means' and 'ends') that through familiarity have become merged (e.g. ecosystems as habitat for species, species as functional components of healthy ecosystems).

The conclusion we came to was that concepts must be communicated in multiple ways, for example, with clear abstract descriptions (like the block and arrow models in Chapter 2), with good examples, with local examples, and through self-discovery. The key challenge in developing the tool (Chapter 5) was designing a structure and set of questions to help people work through the concepts with minimal scope for linguistic ambiguity through giving old meanings to new concepts because the language is familiar. This will be an ongoing challenge in further refinement of the tool.

6.2.3 *Multiple dimensions of biodiversity*

One of the most clear contrasts in the project was between the way people talked about how they personally experienced and valued the biodiversity in their area, and how the objectives they use articulate the values their strategies are seeking to conserve. Quite demonstrably, people valued a range of very different aspects of biodiversity, so different we refer to them as dimensions. When speaking of their experiences and values, these different aspects of biodiversity were not surrogates for one another, or management means to outcome ends; they were unique contributors to people's wellbeing. The richness of this diversity of value was very much lost in translation to the institutional form. As noted above, some of the reasons for this are institutional path dependency, lack of concepts and lack of clear language, and lack of necessity to address multiple values separately in a stationary climate.

Defining the dimensions of biodiversity and how to describe the various attributes of them was difficult, yet it is an important part of implementing the climate-ready conceptualisation. We had some success with species, ecosystems and landscapes as three clearly different dimensions that people experience in different ways, but our use of this is ontologically distinct from the use of the same terms to represent scales of biological organisation. We also used the notion of the variety of biota (identity and diversity of genes, species, communities), the quality of biodiversity (e.g. ecosystem health), quantity of biodiversity (e.g. biomass, area of bush, proportion of environmental flows). Both of these sets of dimension were also used in various strategic documents we assessed. Possibly the simplest distinction is between aspects of biodiversity associated with 'biota' and those associated with 'place'. In a stationary climate these are highly correlated and we typically do not make the distinction; but the difference between *conserving a species* as it responds to climate change potentially in a new location (including a zoo or even freezer) is quite distinct from conserving the biodiversity in a fixed place as it responds to climate change with species coming and going and ecosystem processes changing. The need to be aware of species moving in order to conserve them is becoming mainstream, but the complementary concept of the transient biodiversity of a fixed location is not well established (but not absent, e.g. Hobbs et al. 2009).

We have very good science, terminology and theory to describe and predict many different properties of species, and it is relatively easy to anticipate the ways they might change under climate change. However, for species and ecosystems the task of describing different attributes, recognising how they contribute to value and anticipating how they might change is less straightforward. The concepts are not novel. Ecosystem health, and its applicability to both natural and human-influenced ecosystems, has been described by Karr and others (Karr et al. 1986, Karr 1996); and important processes of landscapes – such as primary production, and its sequestration by people – have similarly been documented for decades (Vitousek et al. 1986). Patterns in landscapes and concepts of wilderness have been described in the conservation literature. However, the concepts and language to describe the value of these dimensions to people (as opposed to species) is not nearly as available to conservation stakeholders, planners or policymakers. We see this as a significant current knowledge gap.

Finally, when our exploration of multiple values turned to people talking about what mattered to them, rather than science or policy documents, it was not constrained. We argue, and the project findings reinforce, that people and their values are essential for recalibrating conservation values. However, it is important how that is done – what concepts are used to interpret descriptions – as language can be very ambiguous.

6.2.4 'There are known unknowns, and unknown unknowns'

All the strategic documents and case studies identified mechanisms or methods for addressing some level of uncertainty in conservation. Most common were adaptive management and resilience. Typically these were framed around addressing either the natural healthy dynamics of systems in response to a variable environment and disturbances or the unknown ecological responses to different management. These concepts are widespread in contemporary conservation strategies and are frequently presented as responses to the challenge of climate change; however, we found they are most often applied within the static paradigm. Thus they may be useful as significant changes in biodiversity are managed, but they are not per se sufficient in a climate-ready framing. Indeed, it is possible that their application within the static paradigm could encourage resistance to climate change, which might reduce the ability of biodiversity and managers to adapt to climate change; this is exemplified in the phrase 'resilience *to* climate change', as opposed to 'resilience *under* climate change'.

We propose that further research and policy development are required to improve how these and other approaches to uncertainty and ecological dynamics are applied in conservation strategies.

For example, there are many more unknowns that will affect biodiversity and its management under climate change: the rate of global climate change, ecological responses to climate change, changes in other threats, changes in community values, and uncertainty about the effectiveness of management options. Adaptation in response to new information will be essential regardless of how robust (insensitive to uncertainty) plans and management might seek to be. However, planners need to reassess what new information they will be responding to and how they will obtain it. For many situations access to, and use of, nationally collected information may be just as relevant as local observation and monitoring.

6.3 Revising objectives

The review and case study phases of the project confirmed the initial proposition of the project that assessing and redesigning objectives is a key step on the pathway to adapting conservation management. This can be both as a step in conservation policymaking and planning processes, and as a diagnosis and capacity building exercise to help decision-makers understand the nature of the climate adaptation task. Most planners, practitioners and scientists are more interested in the efficient implementation of effective management actions than on policymaking. However, the project repeatedly found that current objectives were challenged by our criteria, and revising them could readily lead to altered management. Past practice of leaving objectives implicit or vague will greatly hinder adaptation to climate change.

Each of the criteria has the potential to shape the formation and implementation of new conservation objectives; in that sense they can be described as architectural elements of new objectives: fundamental but subtle.

We found that understanding and implementing the concepts is challenging for planners and managers, even those with high capacity and familiarity with similar concepts. Experience with implementing ecosystem services and resilience thinking has shown that iterative learning is a critical process for translating new concepts into practical outcomes. As such, we conclude that iterative learning is also an essential part of the architecture of the climate-ready conservation.

6.3.1 Climate-ready objective tool

The prototype tool that was developed for assisting NRM planners test and develops objectives consists of a series of questions focusing on the three climate-ready criteria; the questions were designed to create a learning process. This tool is a major contribution of this report and hopefully to the development of climate-ready conservation objectives by planners in a range of institutional contexts.

The tool is in early development. Further refinement, through field testing with regional NRM bodies and other partners, and refinement of communication structures and language, will help improve the usability of the tool. It is proposed that further work cover:

- internal review and refinement of content and presentation of the tool
- facilitated workshops to test tool formats and language with a number of agency research partners
- improved documentation of the process and development of information products to provide a ‘user friendly’ presentation of the tool and aid in its implementation and use.

Use of the prototype tool is intended to be with facilitators very familiar with the climate-ready concepts. It is intended that refinement of the tool will see it developed into a standalone package for conservation decision-makers.

It is anticipated that, if this further work goes ahead, key user groups for this tool will be the regional NRM bodies as they update their planning from 2013 through to 2015 under the new Australian Government Regional Natural Resource Management Planning for Climate Change Fund.

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APPENDIX 1: CONSERVATION DOCUMENT REFERENCES

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APPENDIX 2: PROTOTYPE CLIMATE-READY CONSERVATION OBJECTIVES

This appendix outlines three prototype climate-ready objectives for biodiversity conservation. These have been developed to help illustrate some of the elements of the climate-ready approach and to suggest some directions for the setting of future objectives. Versions of these objectives were workshopped in some, but not all, of the case study workshops. They need to be further refined with greater experience of intersecting them with existing decision-making. This will be a natural outcome of testing and development of the climate-ready tool described in Chapter 5.

There is one objective for each of the species, ecosystem and landscape dimensions of biodiversity that are experienced and valued by society (as described in Chapter 2). Each objective consists of three key elements: an action (reduce or maintain), a biodiversity outcome that is the object of the objective (what it is trying to conserve), and a biodiversity outcome that is seen as transient – that is, change in it is deemed acceptable, by virtue of the inevitability of that change under climate change. While 'acceptable' in this context, these 'inevitable changes' are nonetheless likely to affect aspects of biodiversity that are currently valued significantly by society, leading to loss; we label this 'residual loss' as it is loss that is not avoided in the framing of the objective. These losses could potentially be reduced in the short term through additional objectives and management, but we suggest these are not viable long-term options.

Each objective addresses the first two propositions – accommodating the large magnitude of ecological change and significant uncertainty in the detail of that change – that define the 'dynamic conceptualisation' of conservation (Figure 4). Collectively, the set of objectives address the third proposition – conserving multiple valued aspects of biodiversity – that completes the climate-ready conceptualisation of conservation.

At one level, each objective is quite intuitive, but there are many complexities in the detail that would need to be addressed in implementing the objective. These often arise as the implicit knowledge and understanding about the concepts behind current objectives and aspirations are not well established, hence the difference between current and climate-ready objectives is only revealed with some unpacking. The sections below do some of that unpacking for each objective. First the objective is stated and key features of it are explained. Then sources of ambiguity in the objective and residual losses are outlined. The objective is then illustrated with examples of similar objectives from existing conservation strategic documents, and with examples of the types of management actions that might and *might not* be done under the objective. Finally, some technical challenges to the implementation of each objective are listed under ecological, social and institutional headings. The institutional section notes the difficulty of constructing tools to enable the objective to be effectively implemented in policy, planning and other decision-making. These three topics reinforce the disciplinary research and development needs within this essentially transdisciplinary issue.

A2.1 Species objective

Reduce species extinction, as abundance and distribution change

A2.1.1 Explanation

The intent of this objective is to focus on the continued *existence* of species, with the specific locations and abundances of species seen as transient. The objective explicitly recognises that populations of species may vary considerably over time, and that as these changes occur it may be feasible to reduce the chance of species going extinct, but that it is also infeasible to prevent *all* extinctions due to climate change (and other threats). The objective can be extended to include reducing the loss of genes and (less effectively) ecological communities, capturing the ecological hierarchy of biotic units. It can also be expanded to include patterns of diversity at different scales (richness and turnover between sites).

A2.1.2 Ambiguity

Potential conceptual issues with this objective include:

- How much reduction in extinction is sought, and how might success be recognised?
- Hybridisation is potentially a mechanism for genes to survive in the future despite loss of a distinct population or species, but hybridisation is currently recognised as a threat to some populations.
- Similarly, distribution shifts into different ecological communities might be good for the moving species but potentially threaten the identity of the extant community.
- How much species richness and turnover between sites is desirable? How much does society value other types of diversity (higher taxonomic levels, functional, etc)?
- Is the presence of any species acceptable in any location, at any abundance? This is clearly illustrated by the 'allowable' nature of exotic species in some parts of landscapes but not others. To what extent should the same apply to some or all native species, and in which locations?

A2.1.3 Residual loss

There are two sources of residual losses in this objective. First, there will be losses due to the changes in species abundance and distributions. Species and place are very tightly linked in people's perceptions. Significant losses may result from not being able to experience the presence or desired abundance of a particular species in a traditional location. Similarly, there may be loss associated with the new presence of unfamiliar species in a specific location. Second, there will be losses associated with those species that do go extinct, given an acceptance that some level of extinction is inevitable.

A2.1.4 Example

Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010–2015

> Restoring threatened Ecological Vegetation Communities (EVCs) will ensure a range of habitat types to support the vision.
>
> Rationale: It is not the intention of the targets to maintain all species in their present locations and all ecosystems in their present composition … Rather, they are trying to ensure the availability of a range of habitat types across the catchment.

A2.1.5 Management: Do

Examples of climate-ready management actions for species conservation include:

- Maintain habitat in a wide variety of environment types so species can hopefully find suitable habitat somewhere across the landscape as they move in response to climate change.
- Minimise the impact of other threats (pests, weeds, habitat loss and degradation, water extraction) so that species have less competition to establish populations in new areas (as well as potentially persist in their current distributions).
- Maintain and enhance connectivity of vegetation and waterways to facilitate movement of species to areas where they may survive better.
- Protect refuges to help species survive increased climatic and environmental variability and extremes.
- Protect currently outlying populations as potential sources for populations in new areas.

A2.1.6 Management: Don't

Examples of management actions contra to the climate-ready objective:

- Maintain a specific type of community or population of species in a particular location.
- Maintain current genetic structures of populations.
- Prevent all new species from establishing; prevent any change in communities; prevent change in disturbance regimes.

A2.1.7 Gaps: ecological

Species is the best recognised and characterised of the dimensions of biodiversity. There is a wealth of ecological knowledge to describe species and their dynamics in response to environmental variation, and there is significant research on how species may respond to climate change. There are also many precedents of species being experienced and valued independently of their (original) location, for example, in backyards and zoos. However, species and place are very tightly linked in many aspects of ecological research and characterisation, not the least in the use of maps of species distribution and ecological communities and species lists for locations.

A2.1.8 Gaps: social

Species are also socially the most readily identified and valued dimension of biodiversity, and they are a major motivation for investment in conservation. However, again species and place are strongly linked, and this is potentially a barrier to adopting the climate-ready objective. It is unclear how much of the value of a species is linked to it being in its familiar location, and what factors influence how new species might be experienced and valued, positively and negatively. How important is diversity and difference in diversity between locations? How much do threatened species as opposed to common or more familiar species contribute to wellbeing? If some level of extinction is inevitable, how are choices made about which species are preserved? How can the community gauge success if some (uncertain) amount of loss is inevitable?

A2.1.9 Gaps: incorporating into institutions

Species are already well incorporated in current conservation institutions. However, this is often spatially explicit, for example, through maps of threatened ecological communities that might be used in planning developments or restoration works. Current institutional articulations of species are also dominated by threatened species, which might be challenging in the face of rapidly increasing numbers of threatened species. There is a need to develop a-spatial or more spatially dynamic ways of characterising species and their future conservation needs. There is extensive work on characterising diversity patterns, but translating this into forms that can be incorporated into objectives or priorities is more complex.

A2.2 Ecosystem objective

Maintain ecosystem health as type, composition, structure and function change

A2.2.1 Explanation

The intent of this objective is to focus on the quality or health of an ecosystem found at a particular location, with the specific type of ecosystem at that location seen as transient. It explicitly recognises that changes in species abundance and distributions and changes in disturbance regimes will affect the composition, structure and function of ecosystems – their defining features. However, there is an intuitive concept that any type of ecosystem could be in a healthier or more degraded condition, and as type changes it would be desirable for a location to transition from having a healthy ecosystem of the current type to a healthy ecosystem of a new type rather than a degraded version of the original type (or the future type). Ecosystem health could be seen as the potential of an ecosystem to provide ecosystem services.

'Ecosystem', in this objective means the system of the interacting ecological processes and individual organisms. As such, an ecosystem could be small: a patch of vegetation; or very large: for example, the Great Barrier Reef ecosystem, which has reach to the tablelands and floodplains, where inflows originate picking up sediment and nutrient, across the lagoon, to the oceanic currents with their chemical, physical and biotic loads.

This objective focuses on the biodiversity *of a location* as it comes and goes and changes, not on the fate elsewhere on the continent of the individual species or ecosystem types currently occurring at the location. While being described in terms of a place, the objective potentially applies to all places in Australia, for example, backyards, crops, pastures and so on, as well as to native ecosystems: 7.7 million square kilometres of healthy ecosystems.

A2.2.2 Ambiguity

Potential conceptual issues with this objective include:

- The objective is about the properties of ecosystems that people experience and value directly, not about managing ecosystems for the conservation of species per se.
- How should ecosystem health be defined? Can health, or benchmarks for relevant parameters, be defined completely independently from type? What parameters should be included?
- Some loss of health might be inevitable during (continual) transition, depending on the rate of change.

- If change in type is deemed acceptable, due to being inevitable under climate change, then how much is change in type due to human activities also acceptable? This is particularly challenging when climatic and human drivers have the same impact, for example, reducing flows in wetlands.
- How should health benchmarks for novel or transitioning ecosystems be determined?
- While it applies to all ecosystems, which places might be higher priority? Should we aim for examples of very good ecosystem health, or acceptable ecosystem health everywhere?

A2.2.3 Residual loss

Residual losses in this objective arise from changes in types of ecosystems occurring at specific locations, and potentially the extent to which some ecosystem types reduce or disappear completely from the continent. Significant value may be associated with being able to experience (in some way) the types or 'look, sound and smell' of ecosystems people are familiar with or expect at particular locations.

There may also be some loss of value associated with some reductions in ecosystem health as they enter a phase of continual transition in response to continual climate change, so that they are essentially always out of equilibrium with the climate of the day.

A2.2.4 Example

Murray–Darling Basin Proposed Basin Plan

> (b) to protect and restore the ecosystem functions of water-dependent ecosystems; and
> (c) to ensure that water-dependent ecosystems are resilient to climate change and other risks and threats

A2.2.5 Management: Do

Management actions for climate-ready conservation of ecosystems include:

- Manage disturbance to avoid any erosion of key parameters (e.g. soil, trophic structures, primary productivity)
- Limit 'over dominance' of key species (monocultures, over predation)
- Manage extractive pressures (e.g. grazing, harvests)
- Manage for diversity of functional types and manage for ecological redundancy
- Manage for resilience of key processes.

A2.2.6 Management: Don't

Examples of management actions contra to the climate-ready objective:

- Manage to maintain the current types of ecosystems at particular places
- Use benchmarks or definitions of condition or health that are defined with reference to the current type of an ecosystem
- Manage an ecosystem type as it shifts across the landscape (rather, manage changing ecosystems at places).

A2.2.7 Gaps: ecological

Ecosystems and ecosystem function are widely studied, therefore there is a large knowledge base to build on to understand properties of ecosystems independent of their types. However, much of this science has not been applied to conservation. Most ecosystem focus in conservation is on managing ecosystems to maintain type or provide habitat for specific species.

Key gaps include:

- An agreed definition of ecosystem health; indeed, many ecologists reject the term ecosystem 'health', although many aspects that might intuitively align with health are well defined ecologically (e.g. species richness, functional diversity, primary productivity, response to disturbance)
- A variety of measures related to ecosystem health (e.g. condition) that are decoupled from the type of ecosystem
- Defining suitable benchmarks as the climate changes. Some changing benchmarks might be predictable from current theory, mechanistic models and statistical analysis of patterns, such as potential primary productivity or species richness. However, it is unclear if these predictions or extrapolating from similar contemporary climates will be precise enough or actually suitable.

A2.2.8 Gaps: social

Ecosystem health is very intuitive, leveraging off the metaphor of human health. However, the link between ecosystem type and place is very strong in our experience, culture and psyche. While many people might not be able to identify or readily describe different ecosystem types, they are likely to be able to readily notice differences between them. Hence change in type is likely to be noticed, affecting how the ecosystem is experienced and potentially leading to loss. On the other hand, degradation of ecosystems is also readily noticeable and often clearly undesirable. How much of the value held for the ecosystem at a place is associated with the type of the ecosystem and with its health? How much does the rate of change in type matter socially? How much does familiarity with the current ecosystem affect perceptions of change in type and health?

A2.2.9 Gaps: incorporating into institutions

There are many possible different measures relevant to ecosystem health, but few are well enough characterised to provide simple tools to be built effectively into institutions. Potential measures include primary productivity (the difference between potential and actual), species richness, structural diversity, and response to disturbance. However, as noted above, benchmarks for these measures might be difficult to determine.

A2.3 Landscape objective

Maintain a balance between human and natural domination of ecological processes, as ecosystems and land/water uses change

A2.3.1 Explanation

The intent of this objective is to focus on the amount of nature in a landscape, with the particular native ecosystems and human uses in the landscape seen as transient. It recognises landscapes as places with a mixture of natural and human influences, and it focuses on the balance between those influences. In some landscapes it might be easy to recognise the balance in terms of the area of native ecosystem and the area of development. But in many landscapes there will be some degree of human influence over native ecosystems (e.g. grazing, logging, wild fisheries), or the demarcation of a native ecosystem is ambiguous (e.g. native forest plantation, native garden). Similarly, river flow regimes or wetland flooding or fire regimes can have an element of human and natural control. A more general description might therefore be the balance between natural and human domination of ecological processes across the landscape. This can span all ecosystem types, including natural and human-crafted ones.

Like the ecosystem objective, this one is place-based, but here the place is recognised as having multiple ecosystem types (including natural and human) and the focus is on the 'quantity of nature' across those different ecosystems or the quantity of resource available for nature, not the quality of it. Where the ecosystem objective related to the ability of a place to provide ecosystem services, this objective relates more to the quantity of ecosystem service provided by the landscape. The objective can apply to any scale, for example, the continent as a whole or an urban backyard.

In many ways this balance has been a major focus of many conservation 'battles' and resource planning debates in Australia (e.g. forestry agreements, dam building, water allocation, mining), although most have not been expressed in that way.

A2.3.2 Ambiguity

Potential conceptual issues with this objective include:

- The objective is about the properties of landscapes that people experience and value directly, not about managing landscapes for the conservation of species per se.
- What 'balance' of human and natural domination is right? While this is clearly a significant question in society, this objective focuses on the impact of changes in the balance due to climate change. It does not imply more natural is better. Rather, it recognises that all landscapes fall somewhere on the spectrum from wilderness to 'car park', with the balance determined historically by various institutional processes, and that, in many landscapes, climate change has the ability to change that balance as ecosystems and human activities change in response. Where the balance (not just the types) affects how people experience and value a landscape, then it may be desirable for any change in the balance to be managed (stopped, slowed, maybe encouraged) rather than just allowed to happen.
- Climate change could drive the balance towards more or less natural domination. Either could be desirable, depending on the landscape and the interested communities.
- Is the pattern of natural and human activities, and how they are spread across the landscape, important, as well as their relative amounts?
- What aspects of ecosystems, ecological processes and human impacts should be used to judge the extent to which they are naturally dominated? How should human impact on variation be considered (e.g. flow regimes)? How might impacts on view-scapes and sound-scapes be considered?

A2.3.3 Residual Loss

Residual losses in this objective arise from changes in the *types* of ecosystems and land and water uses occurring in the landscape. Clearly, specific ecosystem types and human uses are valued in many landscapes, and change in these will lead to some loss.

A2.3.4 Example

Australian Biodiversity Conservation Strategy, 2010–2030

> Target 4: By 2015, achieve a national increase of 600,000 km^2 of native habitat managed primarily for biodiversity conservation across terrestrial, aquatic and marine environments.

A2.3.5 Management: Do

Management actions for climate-ready conservation of ecosystems include:

- Understand the institutional and physical drivers of particular balances in landscapes, and their sensitivity to climate change, both directly and via changed land and water use
- Set aside land and water resources for biodiversity
- Include the naturalness of semi-natural ecosystems and rivers in quantification of landscape balance (as opposed to simply area of native habitat vs. cleared)
- Maintain natural influences over variability in hydrological systems and disturbance regimes
- Adjust harvest (fishing, grazing, timber harvest) in response to changing productivity.

A2.3.6 Management: Don't

Examples of management actions contra to the climate-ready objective:

- Manage to maintain specific ecosystem types and land and water uses
- Set fixed harvest amounts
- Maintain historic disturbance regimes in all circumstances
- Manage to maintain examples of types of ecosystems or environment types (rather, manage for quantity).

A2.3.7 Gaps: ecological

Managing landscapes for the persistence of species is a major focus of conservation ecology. This includes managing amounts and patterns of habitat, which may be aspects valued by people, but their benefit is usually quantified for native species not for people. There is some, but much less, focus in research on characterising the amount of nature or natural processes in landscapes (e.g. human appropriation of primary productivity, characterisations of wilderness, aesthetic view-scapes, greenness in urban ecosystems). As a result, there is a paucity of ecological measures for characterising different aspects of the naturalness of landscapes. This is especially the case away from the extreme ends of the spectrum from 'wilderness' to 'human domination'. Indeed, landscapes towards the middle of the spectrum might be more likely to experience a change in the balance.

A2.3.8 Gaps: social

People connect very strongly to landscapes. Protecting wilderness and maintaining amounts of nature in landscapes have been strong drivers of conservation movements, and rural communities are frequently strongly connected to the mix-use nature of their landscapes. The tree-change phenomenon is partly about seeking some balance in landscapes. However, in formal conservation institutions and tools, landscape balance for people has far less presence that managing landscapes for species. As above, this is particularly evident towards the middle of the spectrum, as opposed to the ends where both wilderness and small fragments respectively might be formally recognised. Despite the demonstrable community associations with naturalness in landscapes, this property is often less prominent than species preservation in narratives about biodiversity and its conservation.

Sense of place is a powerful concept in culture; how much of it is tied to familiar types of ecosystems, as opposed to a balance? If types change, how much connection might remain? Is the balance worth retaining if the types change?

A2.3.9 Gaps: incorporating into institutions

Designations of wilderness and specific areas of significant heritage (e.g. World Heritage) are readily formally recognised, and fragments of native ecosystem are recognised by virtue of being listed as threatened. Similarly, prohibition on broadacre land clearing can contribute to maintain a landscape balance. However, there are few readily available tools for effectively characterising the degree of human and natural influence along the spectrum of balance in a landscape; possible measures include VASTS (Thackway & Lesslie 2005) for terrestrial ecosystems, and various characterisations of river flows.

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