

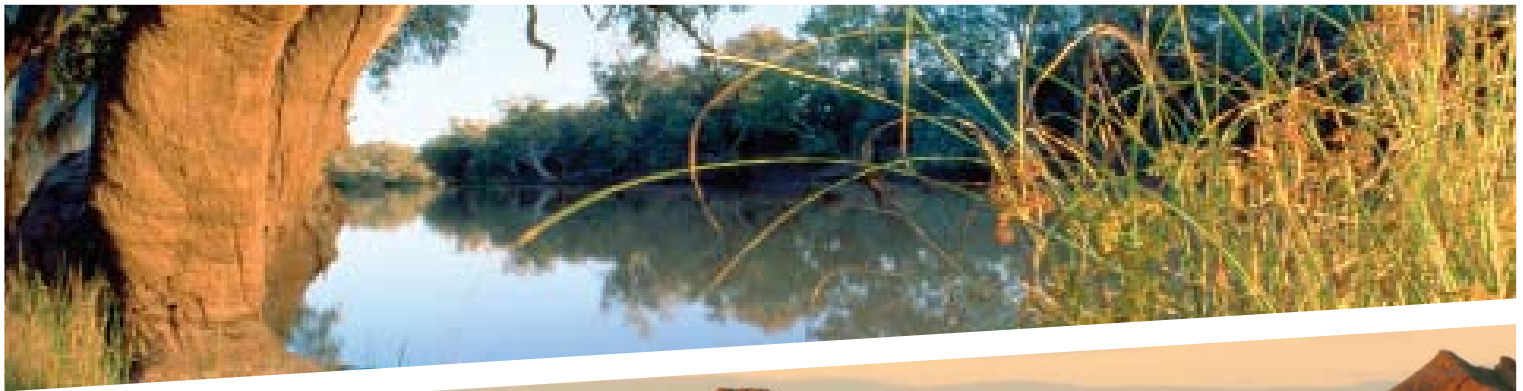


Australian Government

**Department of the Environment,
Water, Heritage and the Arts**



OVERVIEW OF THE REPORT IMPLICATIONS OF CLIMATE CHANGE FOR
AUSTRALIA'S NATIONAL RESERVE SYSTEM: A PRELIMINARY ASSESSMENT



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This short document is a simplified overview of the report *Implications of climate change for Australia's National Reserve System: A preliminary assessment* (2008). The full report was commissioned by the Australian Government and undertaken by the CSIRO. This overview is intended to assist discussion on the issues raised by the full report. It is not an Australian Government response to the report. Biodiversity managers are encouraged to read the full report, available at www.climatechange.gov.au/impacts.

The National Reserve System is Australia's nation-wide network of protected areas – covering national parks, conservation areas on private land, Indigenous Protected Areas and other reserves – which conserves our unique landscapes, plants and animals for current and future generations.

The full report pulls together existing knowledge on biodiversity and climate change to outline the impact climate change is likely to have on Australia's National Reserve System. It also investigates the consequences of these impacts for the development and management of the National Reserve System.

This overview aims to represent the findings of the full report as accurately as possible, but given the complexity of many of the issues discussed in the report it is sometimes difficult to put them in simple terms. Please see the full report for more detail. The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government. While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the Australian Government does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

The full report is one of a series of scoping studies being undertaken by the Department of Climate Change and the Department of the Environment, Water, Heritage and the Arts. These include, among others, an assessment of climate change impacts on World Heritage Areas. It is one of a number of sources of information that the Australian Government will use to inform action on climate change.

The full report

Michael Dunlop and Peter R. Brown (2008) *Implications of Climate Change for Australia's National Reserve System: A Preliminary Assessment*, CSIRO Sustainable Ecosystems, report to the Department of Climate Change and the Department of the Environment, Water, Heritage and the Arts, Canberra.

The full report and additional information about the implications of climate change for Australia's biodiversity and for biodiversity managers can be found at www.climatechange.gov.au/impacts

To find out more about the National Reserve System visit www.environment.gov.au/parks/nrs

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1. Key points from the report



Nick Rains



Nick Rains



Australia's biodiversity will be affected by climate change in many different ways.

In some places, the types of plants and animals living there will change. In others, the same types of plants and animals will remain, but their numbers will go up or down.

Many native ecosystems will gradually change from what we see today. This will change the way we interact with our natural environment.

Climate Change could change the entire look, sound, and smell of the landscapes we are familiar with, and affect the very existence of many of our iconic species.

Climate change threatens our biodiversity in four key ways:

- By changing the availability and use of water
- By prompting native and exotic species to move into new areas
- By stimulating changes in land uses
- By altering fire regimes.

Environmental change is inevitable – the challenge for biodiversity conservation is to be able to manage change to minimise undesired losses.

A well informed community debate is needed to determine what changes in the environment are acceptable, and what changes we should try to avoid.

Climate change impacts will vary considerably between species and will be very hard to predict. Therefore probably the best approach to minimise loss will be to make sure many different types of habitat are protected.

This way even if the ecosystems and habitats change, a wide range of environmental conditions will be available to help native species survive. Larger areas of habitat, and more of them, will also be required to help species adapt to changing conditions.

The 'bioregional framework' used for building the National Reserve System is very well suited to this new challenge. It is already designed to develop a system of protected habitats across the continent that helps our biodiversity adapt to a broad range of environmental conditions.

The National Reserve System already covers more than 11 per cent of the continent and it contains many areas that are vital for the survival of Australia's plants and animals. Some of the native ecosystems only occur inside parks and reserves, or are limited elsewhere. The National Reserve System includes core habitats for many native species of high conservation value.

Unfortunately, many of Australia's ecosystems are not yet adequately protected. As a result of climate change, it is more urgent than ever that more key habitats are added to the National Reserve System. New additions need to target a diversity of ecosystems across poorly protected environment types, with a particular focus on minimising loss of key species.



2. Australia's biodiversity and the National Reserve System

The Australian landscape is defined by its native ecosystems – its eucalyptus forests and woodlands, deserts, rainforests and grasslands – interspersed with intensive agriculture and urban development. Our plants and animals are a key part of what makes our landscape uniquely Australian.

This landscape is constantly changing in response to a variety of natural process, a variable climate, and many thousands of years of human occupation, including 220 years of European settlement.

The National Reserve System provides a safety net for native species and ecosystems, reducing their risk of decline or in the worst case becoming extinct. However, it doesn't yet include enough land to adequately cater for all native species and ecosystems. With future changes to Australia's climate exceeding anything previously experienced, even more protected areas will be needed across the full range of Australian environments.

Building a comprehensive, adequate and representative National Reserve System is an essential part of the fight against the impacts of climate change on Australia's biodiversity. It will also have many positive benefits for the wider Australian landscape.

Our historical approach has been to protect areas of high conservation value. We aim to protect examples of all native ecosystems across this vast continent – as places of beauty and as homes to native plants and animals often found nowhere else.

This approach is embedded in the National Reserve System. This has served Australia well and, on a global scale, is the envy of many countries, although many ecosystems are yet to be adequately protected.

As climate change takes effect, there will be changes in the abundance, diversity and distribution of species and ecosystems. There have already been important changes to native ecosystems and species in some areas. The challenge now is to more effectively manage threats such as fire, weeds and feral animals in protected areas, to help native species respond and adapt to changing environmental conditions, so we minimise the loss of key species and their habitat.



Graeme Worboys

Billybuttons, Australian Alps

Warmer and drier conditions in the Australian Alps threaten alpine plants such as the billybuttons, which needs snow patches and frosts to survive. Alpine wildlife stands to be affected too.

In the Alps loss of snow cover has already led to declines in populations of small animals that are active under the snow during winter, such as the dusky antechinus, mountain pygmy possum and the broad-toothed rat.

In contrast, feral animals such as pigs, rabbits and horses are able to forage higher up in the mountains for longer. The impacts on alpine vegetation due to increased burrowing, rooting, trampling and grazing by both exotic and expanding native species are likely to be substantial.

3. Climate change will affect biodiversity in many different ways

To prepare for climate change it is important to understand all of the different ways in which species and native ecosystems will be affected in Australia. The environments in which species live will undergo many types of change, each affecting biodiversity in different ways.

Expected impacts on the environment

- Increases in the concentration of carbon dioxide
- Increasing temperatures, with some regions, seasons and daily patterns changing more than others
- Changes in rainfall, with less rain in some places and more rain in others, as well as changes in seasonal patterns, changes in the intensity of rainfall, and changes to the amount of time some places go without rain
- Changes in the frequency, timing and severity of floods, storms, heatwaves and fire
- Rising sea levels, as well as increased sea temperatures and acidity.

Expected impacts on individual plants and animals

- Changes in the concentration of nutrients and toxic chemicals in leaves
- Changes in growth and water use in plants
- Changes in the dates of seed germination, flowering, egg laying and hatching in birds, reptiles and insects. For example, many things that usually happen in spring will occur earlier in the year, and things that often happen in autumn will happen later
- Changes in the behaviour of animals.

Changes in how species interact with each other will be particularly important, including pollination, seed dispersal, competition, predation and diseases. This means that a direct impact of a changing climate on one species could lead to an indirect impact on another. These impacts could be negative, for example fewer pollinating insects leading to reduced pollination success in plants, or positive, with some species thriving with fewer competitors for available food. In many situations these indirect impacts could be more significant than direct climate impacts.



Nick Rains

Pygmy possum in eucalypt tree, Gluepot Sanctuary South Australia

One fifth of Australia's eucalypt species are found in areas where average annual temperatures vary by less than 1°C. An increase beyond this range could see local extinctions. With an increase of up to 3°C, more than half of eucalypt species are potentially at risk.

Expected impacts on populations of species

- Changes in species abundance, with some species increasing in numbers and inhabiting new and larger areas, and others species decreasing
- Changes in the places species are found, with changes in temperature and rainfall patterns encouraging some species to move to new areas. For some species this will mean moving to cooler climates, often up-hill or southward. But such changes will also be affected in unpredictable ways by changes in carbon dioxide concentration, other interacting species, and the availability of suitable habitat
- Changes in the genetics of species, which will occur as they evolve in response to the changing environment and changes in other species.

Different species will be affected in different ways, so in some areas the balance of life will change as some species become locally extinct and others become newly established.

In some instances, whole ecosystems will gradually change, for example changing from a woodland to a grassland as the environment and species change.

These changes will be accelerated by the impacts of some of the other pressures facing our native plants and animals – increasingly fragmented habitat because of land clearing, weeds and feral animals, and more frequent fires. Some ecosystems will also change in ways that affect the cultural and material benefits that people currently enjoy. Changes in some places will affect our ability to enjoy them as visitors, work them for agriculture, and rely on them for traditional cultural pursuits.

Reducing global emissions of greenhouse gases, and slowing the rate of climate change, may reduce the number of extinctions and help preserve our environment and the benefits we gain from it. However, even with marked emission reductions, the global climate system is already locked into significant future climate change that will further affect species and ecosystems. Many of these climatic changes are likely to continue for many centuries.



Nick Rains

Migratory red necked stilts feeding on exposed tidal flats.

Almost one fifth of Australia's migratory bird species are potentially affected by climate change through the loss of coastal habitat due to sea-level rise.

4. Climate change will alter how other threats affect biodiversity

As well as affecting species and ecosystems directly, climate change will also influence other major threats to biodiversity – things like weeds, feral animals and frequent bushfires. Changes to these other threats may have a greater impact than climatic shifts.

Four threats are particularly challenging as they already have significant impacts on biodiversity in many regions (with 1600 species now listed as nationally threatened). These four threats also have a strong human element, making management more complicated.

The four 'wicked threats' are:

- changed water availability and use
- the arrival of new (native and exotic) species in a region
- changes in land use
- altered fire regimes.

Protecting Australia's biodiversity from the combined effects of climate change and these four major threats will be challenging. In many situations there will be trade-offs between aspects of biodiversity and important economic and social values (access to water, protection from fire). Solutions will have to be developed on a case-by-case, region-by-region, and species-by-species basis.

Changed water use and availability

Climate change will affect the amount of water available from rain, groundwater and rivers, and the way water is used by plants, animals and ecosystems. Climate change and a growing economy also increase the demand for water for human, industrial and agricultural uses. These changes will affect aquatic species and many other species dependent on rivers, wetlands, floodplains and groundwater for food, water or habitat.

If the societal response to reduced water availability is more dams and increased extraction of water from rivers and groundwater, then biodiversity could be facing a "triple-whammy" from current water extraction, climate change and future increased water extraction.

It will become increasingly difficult to provide enough water at the right time to maintain wetlands and floodplains such as the Macquarie Marshes in New South Wales and river red gum forests in the Murray Darling Basin. 'Environmental flow' water allocations are generally much less than natural flow regimes, and additional allocations are expensive to purchase. We might need to choose which wetland ecosystems we wish to maintain and which we will sacrifice. We may also need to protect locations that have reliable surface waters and accessible groundwater as drought refuges and staging posts for mobile native species.



Murray River



Ian Hutton

Red-tailed tropicbird

There is already evidence that some birds have been affected by climate change. Some tropical seabirds are expanding southwards in Western Australia, which is thought to be linked to changes in ocean temperatures and climatic conditions along the coast. Some migratory birds are arriving at feeding areas earlier than they did a decade ago.



Rainforest encroaching on eucalypt forest in Dorrigo National Park, New South Wales

Expansions of rainforest into eucalypt forest and grassland have been observed in Queensland and New South Wales. Possible causes include changed land use, fire regimes, recent carbon dioxide increases and climate change.

Species moving into different areas

One result of climate change is that some species will increase in number, and some will establish in new areas as the climate becomes more favourable for them.

Some of these 'new' species will be native to Australia; others will be exotic species that have 'escaped' from agriculture or gardens (these are often weeds and pests). They are a potential threat because they can out-compete present species for food, water or habitat, or be significant pests or predators even if there are only a few individuals initially present.

We cannot yet accurately predict which species – native or exotic – will increase and spread, and what the impact of their arrival in new areas might be. Some new species might have little impact on resident species or land use in that area, some might be beneficial, and others will have far-reaching negative impacts.

We are faced with a dilemma as local climates change and species spread in response. Stopping the spread could lead to extinction, as the species may need to shift to a new area, with a more favourable climate, to survive. On the other hand, allowing the spread of one species could cause local extinctions of other species already in the area. How these effects should be compared – and what the management response should be – is something that scientists, managers and other affected parties will need to work out.

Many current exotic weeds and pests, as well as exotic species that are already resident in Australia but not currently a problem, will spread more widely or increase in abundance as a result of climate change. Future climate change needs to be considered when assessing the potential threat from any new agricultural or domestic species that are to be introduced to Australia.

Careful and widespread monitoring is needed to detect trends in species movements. An informed community debate is needed about finding a balance between 'accepting all species changes' and 'regarding all changes as undesirable'. Only then will it be possible to develop conservation principles that guide decisions about managing the spread of native species.



Hobart City Council

Porter Hill, Tasmania

Hobart City Council has acted to protect the city's bush skyline forever by adding it to the National Reserve System.

Changing land uses

Human settlement has already affected almost all of Australia's ecosystems in some way, most noticeably in the establishment of towns and cities and associated infrastructure, plus production forestry and intensive agriculture. In addition, grazing in Australia's vast rangelands occurs in large areas of native woodlands, shrublands and grasslands. In many areas climate change is likely to lead to significant changes in land use which may be detrimental to biodiversity.

The expansion of urban areas along the Australian coast is already a threat to biodiversity. Rising sea levels and changed storm and cyclone intensity brought by climate change will add to this threat in some areas. Rising sea levels will see salt marsh and mangrove ecosystems increasingly squeezed between urban development or agriculture and the ocean. Efforts to secure coastlines from erosion may lead to direct damage to coastal species and ecosystems.

In some areas, increased carbon dioxide, warming temperatures and changed seasonal rainfall will facilitate the expansion of more intensive agriculture. For example, some wet areas may dry out enough to allow cultivation, which would result in the loss of native habitat. Such changes could have very dramatic impacts on remaining native species and ecosystems in areas where biodiversity is already affected by fragmentation and land clearing.

In other areas, climate change may lead to a gradual decline of agriculture, opening up new opportunities to restore and manage native ecosystems for conservation.

Reduced water availability in many southern agricultural areas is leading to renewed interest in developing water resources and agriculture in northern Australia. Such developments would potentially threaten many species and ecosystems in the north, including in the world's largest relatively intact subtropical savannah, which stretches from Cape York to the Kimberley.

Altered fire regimes

Changes in the frequency, intensity and seasons in which wild fires occur – due to climatic changes, and more recently human activities – have helped shape Australia's biodiversity for at least 10 million years.

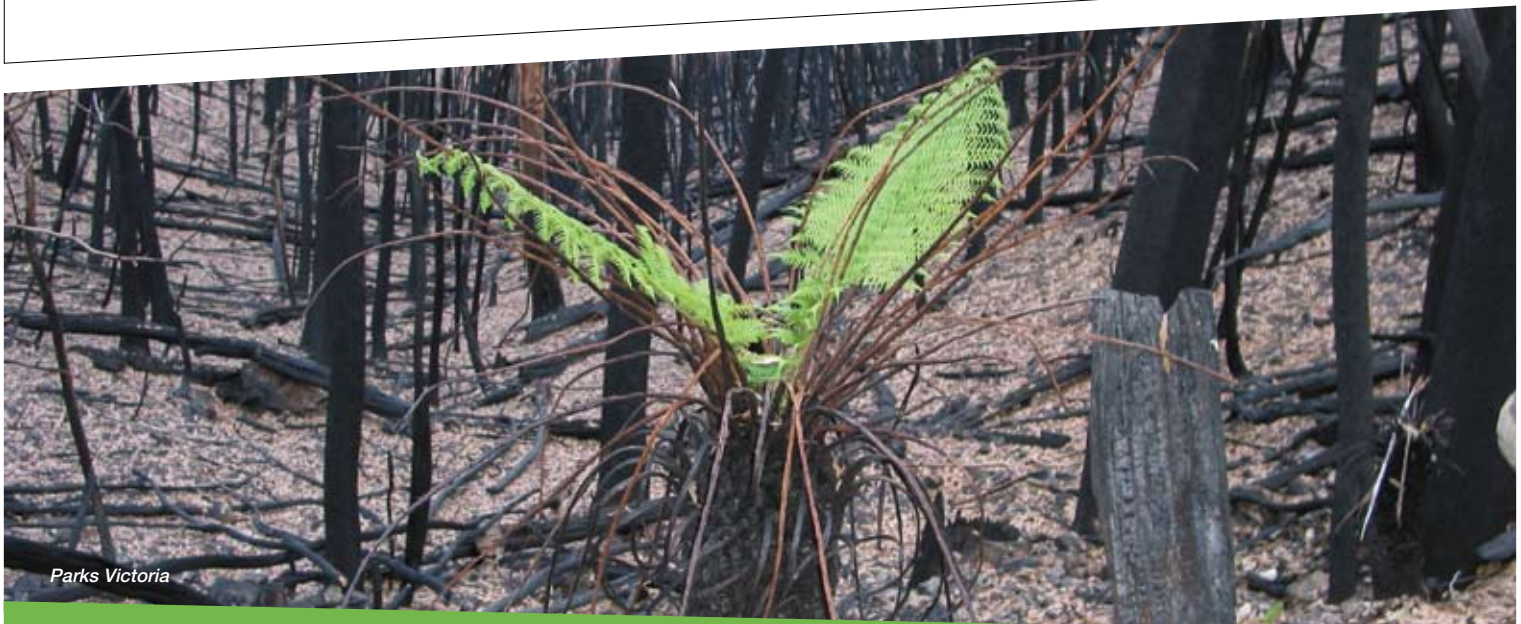
Climate change will drive further changes in fire regimes – by altering the amount, position and dryness of fuel in different seasons, and the frequency of high fire-danger weather and lightning strikes.

Increases in fire frequency and intensity can be expected, with warming and drying in many regions. This will lead to substantial changes in vegetation, with large old trees (which provide nest hollows) becoming more scarce, and species that do not recover rapidly after fire dying out or disappearing from the area. Where this occurs it may eventually lead to changes in ecosystems from one type to another, for example from rainforest to forest, forest to woodland, and woodland to grassland. Habitat for wildlife will change, as will nutrient and water balances.

Many sensitive species may become further restricted to less fire-prone parts of the landscape. Altered fire regimes may also provide opportunity for new species to establish, increasing their chances of surviving. These changes to the Australian landscape are potentially dramatic, as they have been with changes in fire regimes over the millennia.

Increasing fire frequency and intensity is potentially a threat to commercial forests, infrastructure and urban areas.

The question is how should we respond to the changing fire regimes? Efforts to maintain 'historic' fire regimes through hazard reduction burning and vigorous fire suppression may be resource-intensive, of limited success, and have a greater impact on biodiversity than natural changes in regimes. It might therefore be more effective to allow change and manage the consequences. The challenge is to find a way to do this while ensuring some suitable habitat is available for sensitive species, and simultaneously managing the threat to urban areas, infrastructure, and public safety.



Parks Victoria

Regrowth after fire in heathy woodland, Victoria

Climate change will lead to declines in the abundance of many species. If these species have a dominant structural role in an ecosystem then the decline may be very dramatic, especially if the plants or animals are wiped out quickly because of extreme events.

The bushfires that burnt large areas of Victoria, New South Wales and the Australian Capital Territory in 2003 provide an example. Wildfire associated with severe weather burnt up to 1.2 million hectares of bushland, causing mass mortality of canopy species in some locations. In parts of Victoria, almost no adult trees survived.

Although the forests have doubtlessly regenerated from severe fires before, the impact of the fires will be evident for decades; and if there is a second event before new recruits have matured, flowered and set seed, then the character of these forests may be changed for thousands of years.

5. Preparing for a climate of change

There is no doubt that Australia has become warmer in the last few decades, with 2005 officially the hottest year on record. In 2007, southern Australia experienced its hottest year on record. We are also starting to see what could be the early signs of long-term changes to rainfall patterns and more extreme weather, such as intense storms, floods and droughts. Never before has Australia's biodiversity faced such rapid climate change together with increasing carbon dioxide levels, the pressures of human occupation, grazing by exotic species, feral animal and weed invasion, and massive changes to river flows and fire regimes.

Future changes to the Australian climate are likely to be significant, with clear consequences for our native species, ecosystems and landscapes. It is impossible to predict exactly how each species and ecosystem will be affected, because of the complex nature of how species will respond, how various threats may change, and our poor understanding of many of Australia's native species and ecosystems. However, we do know many will undergo considerable changes over time.

Traditionally, most change to native ecosystems has been regarded as potentially threatening, and conservation has largely focused on preventing change or restoring ecosystems toward a 'pre-European' state. The reality of pervasive change resulting from climate change presents a new challenge to conservation – managing the change, to minimise the loss. This will require us to look at our approach to biodiversity and conservation with 'new eyes'.

This requires a national discussion about the effects of climate change on Australia's biodiversity. What changes might be more likely in different regions and ecosystems? Which species are more vulnerable and which are more adaptable? What changes are acceptable, and what changes might lead to loss? How do we manage the change?



Nick Rains

Patch burning at Mornington Sanctuary, Western Australia

Across northern Australia, altered fire regimes continue to be a major driver of changing habitat. With wildfire tipped to become more frequent and severe in some parts of the country because of climate change, reserve managers will need to make decisions about whether to try and maintain historic fire regimes through hazard reduction burning and fire suppression, or to allow change and manage the consequences.

Managing changes in species and ecosystems

We must accept that change is inevitable; it will be impossible to stop some species becoming extinct in the wild and to prevent ecosystems from transforming. But it is reasonable to try to maintain a high diversity of species and healthy functioning ecosystems, and keep to a minimum the number of extinctions.

A broad debate about what change is acceptable and what we want to maintain is therefore needed. Conservation will then have two objectives:

- Facilitating natural changes in species and ecosystems, including natural adaptation
- Protecting individual species or ecosystems that are particularly threatened and valued by society, as a type of 'safety net'.

In many places management for these two objectives might be the same, for example keeping threats to a minimum and preventing habitat loss. However, in some situations there will be conflicts. Managing natural change could involve encouraging new species to establish, whether for their own conservation or to provide habitat for other species.

In contrast, one highly valued species might survive only if it is protected from other invading species through fencing, spraying and trapping programs (such isolation is already common management for many threatened species). Some species might survive only if protected in botanic gardens, sanctuaries or zoos.

Ecosystem managers will need to actively and strategically choose which objective they are pursuing – facilitating change or preserving the vulnerable – for each species and area they manage.

Facilitating change may require:

- using species that can cope with predicted environmental changes in restoration
- protecting newly establishing native species
- allowing fire regimes to change
- managing reduced flows in rivers and wetlands
- removing barriers to plant and animal dispersal.

On the other hand, preserving vulnerable species and ecosystems may involve:

- restoring with local varieties only
- controlling establishment of new species
- maintaining historic fire regimes
- maintaining historic water flow regimes
- restricting dispersal into the region.



Nick Rains
Monitoring purple crowned fairy wren at Mornington Sanctuary, Western Australia

Some environmental change is inevitable, and climate change is a part of that. The job now for scientists, managers, policy-makers and the wider community is to engage in a national debate about different types of impacts, and what we want to 'save' and why. Research and monitoring will be an important part of informing this debate.



Jane Dermer
Turtle-Miyapunu

Monitoring turtles on the Dhimurru Indigenous Protected Area, Northern Territory, part of the National Reserve System

How biodiversity will respond to climate change

Climate change will lead to many different types of changes to species and ecosystems. Some of these changes may lead to extinctions and loss of other values, but others will not. It will be important to broadly understand the possible changes to species and ecosystems, and the implications of those changes for conservation and the National Reserve System, before:

- deciding what change is acceptable or desirable, and when we should invest in conserving species or ecosystems
- deciding exactly what management actions and strategies should be undertaken at the local, regional or national level.

We need not wait for perfect information about what changes will occur (indeed we will never have that), however well-intentioned but poorly-informed decisions may be ineffective or counter-productive. This means that managers, policy-makers, scientists and the wider community must all engage in a broad debate about different types of impacts and what we want to 'save' and why.

In addition, there is an urgent need for more detailed knowledge to progressively improve the debate and our conservation efforts. Coordinated observation and formal monitoring programs can identify actual changes; more and better-designed research is needed to assess likely future changes on a bioregional basis. Most critically, we need to know more about how climate change will affect native species in terms of their abundance, where they will occur, how they interact, how ecosystems processes might change, how various threats will change, and the role of preserving diverse habitats and landscapes in facilitating changes and protecting vulnerable species.

Protecting habitat: diversity, area, refuges and connectivity

Different ecosystems provide habitat for different species, and regardless of climate change one of the best ways to protect as many species as possible is to protect as many different types of ecosystem as possible.

The National Reserve System uses a bioregional framework for identifying and prioritising areas to be protected, across the range of natural features and climatic conditions found in this country.

Diversity

If a landscape contains a wide range of different habitats, then as the climate changes there are more options to support a wide range of different species and ecosystems. Thus, probably the best way to ensure as many species as possible can adapt to and survive climate change will be to ensure as many different types of habitats are available for native species to occupy. Protecting habitat diversity now is likely to ensure habitat diversity is available in the future. This is true even if we don't know what species currently occur in different ecosystems and we don't know exactly how habitats will change. Therefore, the framework used to develop the National Reserve System, which maximises the diversity of protected habitat, is very well suited for developing a system of protected areas that remains effective under climate change.

Protecting habitat in formal reserves is effective, but it is not always possible. For instance, important habitat is not always available for sale, and some patches of habitat are too small to be viable as stand alone reserves.

A range of other habitat protection schemes are currently available and more are being developed around the country, to ensure more native ecosystems and key habitats are managed for conservation. It may also be necessary to investigate large scale habitat restoration programs in some regions. These schemes could very successfully help to protect a diversity of habitats, by using a bioregional framework, like that used by the National Reserve System, to identify and prioritise areas to be managed for conservation.

Area

As well as protecting a diversity of habitat, more species are likely to have a greater chance of surviving if *larger areas* of habitat are protected. This can be achieved with both larger areas of continuous habitat, and more protected areas. Protecting different areas that have similar ecosystems provides insurance in case one area is affected by a disturbance, and probably provides additional habitat diversity, as no two ecosystems are identical.

Refuges

Some parts of the landscape - for example mountain tops, or places with permanent water or a variety of landforms - are likely to be particularly important for maintaining biodiversity during droughts, fires and times of ongoing environmental change. These places may act as refuges for biodiversity. Where they can be identified, protecting them will help ensure species survive as the climate changes.

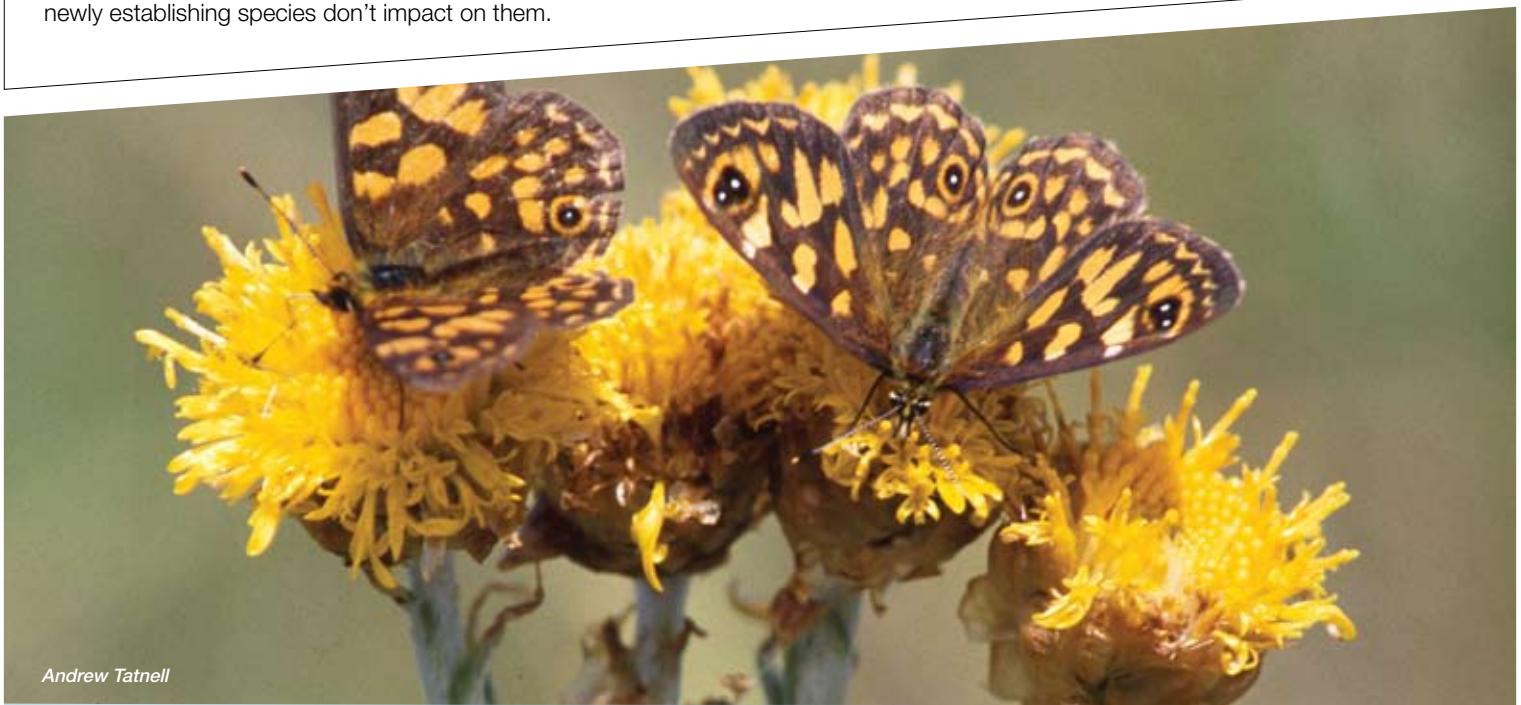
Connectivity

The areas where many species are found will gradually change, as species expand into areas that become more favourable and decline in areas that become less favourable. For this to happen, there must be suitable areas of habitat available, and species must be physically able to get to them. While species such as birds can travel relatively long distances, others species may not be able to spread past barriers of unsuitable habitat – crops, paddocks or towns for instance. For this reason it will be important to maintain and in places increase the connectivity of protected areas into the broader landscape by joining together patches of habitat. On the other hand, for some species, like those restricted to the tops of mountains, survival may depend in part on isolation, so that newly establishing species don't impact on them.

Managing threats in the landscape

By anticipating how threats will change, and adapting our management actions to these changes, it may be possible to control some threats before they become critical and make management difficult. For example, by anticipating where land use may change from low-intensity grazing to intensive grazing, managers may be able to purchase habitat or secure conservation agreements before habitats are degraded and before the land becomes too expensive.

Early establishment of fire buffers and good building design in regions that might become more fire prone will reduce the need for excessive levels of fuel reduction. Therefore, strategic plans for managing the four key threats under future climates should be developed, initially for bioregions where the National Reserve System and biodiversity are most at risk. These plans could then guide and help coordinate programs for managing threats in protected areas, in other areas managed for biodiversity, and across the whole landscape.



Andrew Tatnell

Butterflies on podopelis daisies

In some places, butterflies could lose up to 80 per cent of their current habitat as a result of climate change. Although they can adapt to new plants, they may not be able to migrate to new areas as the climate changes.

Dealing with landscape-scale issues

Climate change will affect entire landscapes and the ecological processes that operate across landscapes: for example, water flow through rivers and groundwater and the movement of migratory species.

This means that land use in one part of the landscape may affect key values in another part – for instance changes to water use upstream would impact on wetlands downstream. The key to managing this is to look beyond the borders of protected areas and work with private land managers to maintain ecological processes across the whole landscape.

In fragmented environments, strategic and well-planned networks of protected habitat, along with the management of threats within protected areas and adjoining lands, are needed to increase the chance that native species will adapt and ecosystems continue to remain healthy.

Such an approach makes it easier to effectively manage key habitats, such as refuges and places that are important for migratory or nomadic species, helping to minimise genetic loss.

The effectiveness of Australian conservation efforts collectively will be improved by the better coordination of on-ground actions within each landscape. This will involve the various engaged conservation programs working together to strategically address climate change impacts, threat management, and conservation objectives for the whole landscape.

The bioregional framework that is used in the National Reserve System is a useful tool to help coordinate activities in such a process.



Wayne Lawler and ecopix

Wetland at Wongalara, Northern Territory, part of Australia's National Reserve System.

6. Implications for the National Reserve System

The National Reserve System is more important than ever

Protection of a wide range of different types of habitat is probably the most important strategy for reducing the negative impacts of climate change on biodiversity. To put it simply: protecting more ecosystems and the variation within each ecosystem now is likely to increase the prospects of more species adapting to and surviving under future climates.

The National Reserve System forms an excellent base, but many ecosystems remain unprotected and should be targeted for inclusion. The National Reserve System also needs to be complemented with other habitat protection schemes. Some species will need protected 'islands' of habitat, while others will need connected chains of reserves. In addition, larger areas and larger numbers of individual plants or animals will be needed to provide the same viability for species as could be expected without climate change.

The bioregional framework is well suited for addressing climate change

The bioregional mapping framework used in the development of the National Reserve System maximises habitat diversity and opportunity for different species, by targeting native ecosystems across the range of environments found in Australia. It is therefore very well suited for building a system of protected areas that is robust under climate change. Indeed, it is likely to be much more effective under climate change than approaches to habitat protection that solely target endangered species and ecosystems.

Management of protected areas will be increasingly challenging

In the near term, climate change will probably pose more of a challenge for the management of individual protected areas than for the future development of protected areas. It is the managers of these areas who will have to deal directly with the implications of climate change, possibly before anyone else has understood the changes and their consequences, and before policies have been suitably revised. Managers will need to make difficult decisions about facilitating change and protecting vulnerable species with little guidance. They also need to play a crucial role in observing and monitoring changes in species, ecosystems and threats across the landscape. Current approaches to dealing with existing threats are based on extensive experience, but they could become less relevant as the climate, the threats and biodiversity change continuously.

The future of Australia's biodiversity is uncertain. More than 95 per cent of native ecosystems have already been modified by threats such as changed water use and availability, invasion by new species, changing land use and changed fire regimes. Climate change will exacerbate these threats and add its own.

Although we do not know exactly what the future climate will be, or how our native species and ecosystems will respond, it is clear that by urgently increasing the protection of the full range of native ecosystems we will help minimise the loss of our biodiversity as it changes in response to climate change.



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