A new Biodiversity Strategy for New South Wales

Discussion Paper

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Department of Environment & Climate Change NSW

Have your say

Written comments are requested by Friday 13 February 2009, addressed to:

Biodiversity Discussion Paper Comments
Department of Environment and Climate Change
PO Box A290, Sydney South NSW 1232

Photographs (clockwise from left): Bird tracks (DEC); Sugarloaf Range (M. Van Ewijk, DEC); Barren Ground Nature Reserve (M. Van Ewijk, DEC); Scribbly Gum Track, Jervis Bay National Park (M. Van Ewijk, DECC).

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Ministers' foreword

The people of New South Wales place a high value on our State's unique natural environment – they enjoy our national parks, forests, rivers and coastline as well as the native plants and animals that are found across the State.

This discussion paper is the first step in the development of a new Biodiversity Strategy which, with the community's support, can help protect our impressive variety of native plants and animals and ecosystems.

The State's first Biodiversity Strategy was released in 1999. It was an important initiative, advancing our knowledge and capacity, and leading to many conservation achievements. Nevertheless, biodiversity in NSW faces significant challenges. As well as continuing to address the legacy of past land-use impacts on biodiversity, we need to tackle ongoing and newly emerging threats, such as climate change.

The 'Environment for Living' theme in the NSW State Plan 2006 seeks better outcomes for native vegetation, biodiversity, land, rivers and coastal waterways, to meet the relevant State targets for natural resource management. As well as maintaining existing biodiversity programs, State agencies will work with Catchment Management Authorities and other partners to identify regional biodiversity conservation priorities.

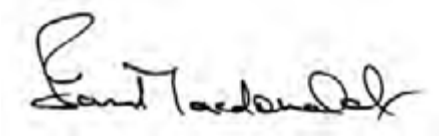
Climate change has the potential to exacerbate other threats to biodiversity and cause shifts in the distribution of plants and animals, particularly if they are impeded by the removal and fragmentation of habitat. There's little doubt that future landscapes will be different, but they need not be biodiversity-poor if we work together with the best available information to keep nature's options open.

Recent reforms in NSW have strengthened our institutional capacity to tackle natural resource management more effectively. They have introduced market-based mechanisms to achieve biodiversity gains where previously there was only cumulative loss. New incentive mechanisms are encouraging landholders to make conservation commitments across the State.

This discussion paper is the first step towards a new Biodiversity Strategy for NSW. It covers a wide range of issues and offers many suggestions for ways to build on our progress to date. Your comments and suggestions will help to make the new strategy effective in safeguarding our biodiversity – and our productive environment – for the future.

Carmel Tebbutt MP

Minister for Climate Change and the Environment



Ian Macdonald MLC

Minister for Primary Industries

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Preface

The quality of life of present and future generations is dependent on conserving biological diversity and using natural resources sustainably. Biodiversity is important both for its intrinsic value and the ecosystem services it provides to society.

The decline in biodiversity is one of the most challenging environmental problems facing NSW. The Department of Environment and Climate Change and the Department of Primary Industries have prepared this discussion paper to canvas the community's views on a new strategy to preserve our precious biodiversity into the future. It outlines a wide range of issues and possible directions for the future, building on the achievements of the NSW Biodiversity Strategy of 1999 and recent initiatives by the Government. For example, the 'Environment for Living' theme in the NSW State Plan 2006 seeks better outcomes for native vegetation, biodiversity, land, rivers and coastal waterways, to meet the relevant State targets for natural resource management. As well as maintaining existing biodiversity programs, State agencies will work with Catchment Management Authorities and other partners to identify regional biodiversity conservation priorities.

Development of a new strategy is a requirement of the *Threatened Species Conservation Act 1995* and an important component of the NSW State Plan. The strategy will encompass terrestrial, aquatic and marine biodiversity.

Slowing and reversing the decline in biodiversity is possible but will require a long-term effort. A Biodiversity Strategy that establishes long-term goals supported by more immediate key directions will help to ensure that biodiversity is conserved for current and future generations, as well as meeting the State's obligations under the National Biodiversity Strategy.

We are seeking your comments on ideas and actions to help develop a framework and key directions for protecting and managing biodiversity in NSW over the long term. We want to capitalise on current programs, commitments and initiatives as well as define new directions. In particular, the approach identified in the discussion paper seeks to:

- build on the achievements of the first NSW Biodiversity Strategy, which provided new assessment work and decision support tools that have underpinned current reforms to natural resource management
- outline the benefits of an integrated and collaborative approach to biodiversity conservation across the landscape – one that involves public reserve managers, private landholders, industry, all tiers of government and community groups and volunteers
- elicit early input into the development of the new strategy in line with the strong commitment to community outreach and engagement given in the State Plan's 'Environment for Living' theme.

Your contribution is important. Early stakeholder and community input will help define community expectations and needs and improve the development of a draft Biodiversity Strategy, which will be released for further public consultation.

The way forward will depend on contributions from all sections of the community. We welcome your comments and suggestions and will use them in developing a strategy which will guide our efforts to slow and even turn around the rate of biodiversity decline and loss, so our natural areas and native species are in a better position to survive well into the future.

Summary

‘Biodiversity’ is the diversity of life on earth and consists of three components: genetic diversity, species diversity and ecosystem diversity. Biodiversity encompasses the complete range of life forms from the most obvious (such as birds, mammals and flowering plants) to the least obvious (such as soil microorganisms), many of which remain unknown to science.

The quality of life of present and future generations is dependent on conserving biological diversity and using natural resources sustainably. Biodiversity is important both for its intrinsic value and the ecosystem services it provides to society.

Biodiversity in Australia, including New South Wales, is declining as a result of a variety of threatening processes, such as clearing, alteration of natural stream flows, invasive weeds and climate change. More than 70 species found in NSW 250 years ago are now presumed extinct, including 24 of the 61 mammals present in the Western Division before European settlement (Lunney 2001), and over 1000 more are listed as threatened. In spite of past losses, NSW retains a rich biodiversity, some of which is recognised as internationally significant.

In 1999, the NSW Government produced the State’s first Biodiversity Strategy, which set the direction for many of the advances achieved since. In 2003, major reforms to natural resource management and land-use planning increased the integration of biodiversity and threatened species management into broader government programs. It did not, however, fully encompass aquatic and marine biodiversity. To address this, the NSW Government decided to develop a new Biodiversity Strategy, and included this important initiative in the NSW State Plan.

To initiate consultation for the revised strategy, the Department of Environment and Climate Change (DECC) and Department of Primary Industries (DPI) have prepared this discussion paper to engage key stakeholders and the community. Once a new strategy is drafted, it will also be publicly exhibited.

This discussion paper identifies the need for a new Biodiversity Strategy that promotes the integration of biodiversity conservation into decision-making at all levels of government, industry and the community, and across the whole landscape. It also proposes that the strategy needs to improve the efficiency and cost-effectiveness of conservation and natural resource management programs for biodiversity. This discussion paper provides the starting point for early input into the development of a long-term strategy to build on current government and community achievements and help set priorities and guide investment.

The discussion paper begins with a summary of the overall approach. Two introductory chapters follow: one to set the scene and one to provide detail on possible goals and principles for the strategy. These are followed by 9 chapters dealing with a wide range of issues, each outlining potential objectives for the strategy and key directions for further consideration. Implementation of these objectives and key directions would take social and economic factors into account.

Goals and principles

The discussion paper identifies a number of goals, principles and objectives for inclusion in the strategy. It adopts the NSW natural resource management (NRM) targets for 2015 and proposes a 20-year strategic goal of widespread biodiversity recovery and increasing landscape connectivity with the involvement of the whole community. It also proposes a 100-year vision of minimising the effects of climate change on biodiversity so that ecological change does not equate to loss of diversity.

The proposed guiding principles are:

- Biodiversity is best conserved *in situ* (that is, in its natural environment) and at all levels: genetic, species and community.
- Maintaining the integrity, dynamics and resilience of natural systems is critical to their functioning.
- Government at all levels should follow the principles of ecologically sustainable development, in particular the intergenerational equity and precautionary principles.
- Habitat connectivity is vital at regional and continental scales, as well as local scales.
- Priority-setting for biodiversity conservation actions should take account of the vulnerability of conservation values to the loss of biodiversity over time.
- Prevention of loss and degradation of biodiversity habitat is the first priority and is significantly more cost-effective and less risky than recovery and restoration actions.
- The importance of biodiversity to Aboriginal culture and the value of Aboriginal people's contribution to conservation are recognised and supported.
- The establishment of a comprehensive, adequate and representative reserve system and sustained conservation across the whole landscape are both central to biodiversity conservation.

Implementation

The proposed strategy would be implemented through a range of existing programs as well as potential new initiatives, some of which are identified in the discussion paper. Successful implementation will call for an integrated effort across the NSW Government and the community. Reporting on progress will be undertaken through the State Plan reporting process and the NSW Natural Resource Monitoring, Evaluation and Reporting Strategy.

DECC and DPI will also prepare strategy implementation reports from time to time. Periodic public forums involving a broad range of stakeholders and community representatives are also identified as a possible approach to support implementation and reporting.

Strategy fundamentals

Four major approaches will be fundamental to the successful conservation of biodiversity under the proposed strategy:

- improved decision-making
- targeted investment in biodiversity
- ongoing commitment to traditional conservation programs
- conservation across the landscape.

Improved decision-making

The recent reforms to NRM in NSW seek to improve the flow of information and quality of decision-making and priority-setting across government programs at State and regional scales. These reforms also aim to promote greater integration of planning and priority-setting, implementation, and monitoring and reporting.

To support these intentions, the discussion paper proposes the development of a series of Regional Conservation Initiatives (RCIs) to guide long-term biodiversity conservation planning and priority-setting at a regional scale. RCIs would be developed with key stakeholders including Catchment Management Authorities (CMAs). This would involve a

review of existing information and priorities, taking account of statewide and regional priorities, opportunities and limitations.

Benefits of this approach include:

- consideration of regional to continental-scale habitat connectivity needs
- an adaptive framework that addresses the potential for range shifts in native and invasive species due to climate change
- pooled resources and economies of scale, including shared information and data-gathering
- a reduced risk of misdirected priorities and investment choices
- agreed overall outcomes, which can be incorporated into finer-scale decisions, including the application of market-based instruments.

Targeted investment in biodiversity

The discussion paper recognises that it is more cost-effective and less risky to invest in retaining biodiversity than in trying to restore habitat or recover threatened populations and ecological communities. Once the damage is done, however, conservation needs to address both retention and repair. Conserving most of our remaining species over the long term will require a gradual but progressive increase, across many decades, in the area of land and aquatic habitat managed for biodiversity and an increased volume of environmental flows in our rivers.

Development of a coordinated and long-term investment strategy is proposed, incorporating innovative and effective mechanisms for funding biodiversity conservation, such as market-based instruments. There are many significant sources of funding that can be applied to biodiversity conservation including Caring for our Country, Water for our Future, the NSW Environmental Trust, and a range of research programs.

To optimise the use of these funds it is important that sound conservation priorities are built into the various investment planning and strategy processes of funding bodies including CMAs. Conservation actions can be staged over long periods and, with a long-term investment framework, the scale and benefits of short-term investments will be more effective and sustainable due to the improved coordination.

Ongoing commitment to traditional conservation programs

The establishment of reserves such as national parks and marine parks is an important and effective conservation measure which will continue. Reserve management will also be an ongoing focus, with continuing management efforts to address threats from pests and fire, the legacy of past land uses, and future threats from climate change.

The discussion paper identifies a long-term need to expand the area managed for conservation on both public and private lands. RCIs will review priorities for protected area establishment to inform investment planning and support the efforts of CMAs, local government, conservation organisations, industry and individual landholders on all tenures.

Efforts to protect and recover threatened species are vital and will continue with the help of the new Priorities Action Statements prepared by DECC and DPI. The discussion paper acknowledges the need to refine the recovery prioritisation process and monitor the effectiveness of recovery and threat abatement actions.

Conservation across the landscape

If applied widely enough, sympathetic management of all land uses, including new ways of integrating biodiversity conservation with production, can significantly improve biodiversity at the site scale, as well as across the landscape.

A range of mechanisms are currently being used to attract landholders to biodiversity conservation. There is also increasing public interest and investment in encouraging landholders to undertake conservation actions on their land. The new strategy will need to support widespread and longer-term commitments from both public and private landholders that are consistent with State and regional biodiversity conservation priorities and addressed in a coordinated manner across the landscape.

Proposed objectives for these issues are to:

- improve coordination of biodiversity conservation efforts
- improve decision-making and priority-setting
- improve mechanisms to protect biodiversity at landscape scales
- maintain an effective regulatory environment to protect biodiversity
- optimise biodiversity outcomes from investment
- continue to support the reserve system
- expand protected areas to complement the reserve system
- recover threatened species and mitigate key threatening processes
- improve biodiversity outcomes across the landscape.

Knowledge and information

A key to slowing biodiversity decline will be our capacity to acquire meaningful knowledge that can be applied in decision-making and management. There are many gaps in our understanding of NSW biodiversity. In addition, there are some key information requirements needed to support the Government's biodiversity reform agenda.

Proposed objectives to obtain the knowledge and information required are to:

- establish a comprehensive biodiversity research program
- develop a comprehensive biodiversity information program, to implement and build on the NSW Natural Resource Monitoring, Evaluation and Reporting Strategy.

Aboriginal people and biodiversity

The close association between Aboriginal people and biodiversity, and the contribution they can make to its conservation is significant in the future vision for biodiversity.

Proposed strategy objectives are to:

- work with Aboriginal landholders in the conservation of biodiversity
- increase understanding of the Aboriginal cultural values of biodiversity
- improve access to biodiversity for Aboriginal people
- increase Aboriginal involvement in the management of biodiversity.

Community involvement

Conservation of biodiversity requires long-term commitment and cooperation between all levels of government, the community and the managers of land and water. Community

involvement is therefore a vital component of the proposed strategy. The discussion paper highlights the need to increase landholder engagement and community understanding and awareness of biodiversity conservation, and enhance community partnership and leadership.

Partnerships between CMAs, the State Government, local councils and landholders are important for biodiversity conservation. Possible objectives for involving the community, as identified in the paper, are to:

- increase landholder engagement
- increase community understanding and awareness
- enhance community partnership and leadership.

Climate change

Observed impacts on biodiversity of changes in climate include its effects on species' physiology, species' distribution and the timing of life-cycle events. Future impacts are expected to be severe.

To address the impacts of climate change on biodiversity, the discussion paper recognises the need for the strategy to include approaches that both adapt to the impacts of climate change on biodiversity and mitigate its effects. The objective proposed is to:

- identify and manage impacts of climate change on biodiversity to minimise species loss and build ecosystem resilience

Invasive species

Pests and weeds on both public and private land threaten many species, populations and ecological communities in NSW. Strategy objectives for managing invasive species could include to:

- limit establishment of new invasive species
- improve management of emerging and widespread established invasive species
- establish refuges for native species most threatened by invasive species
- improve knowledge and tools for responding to invasive species
- increase community support and involvement in management programs for invasive species.

Terrestrial biodiversity

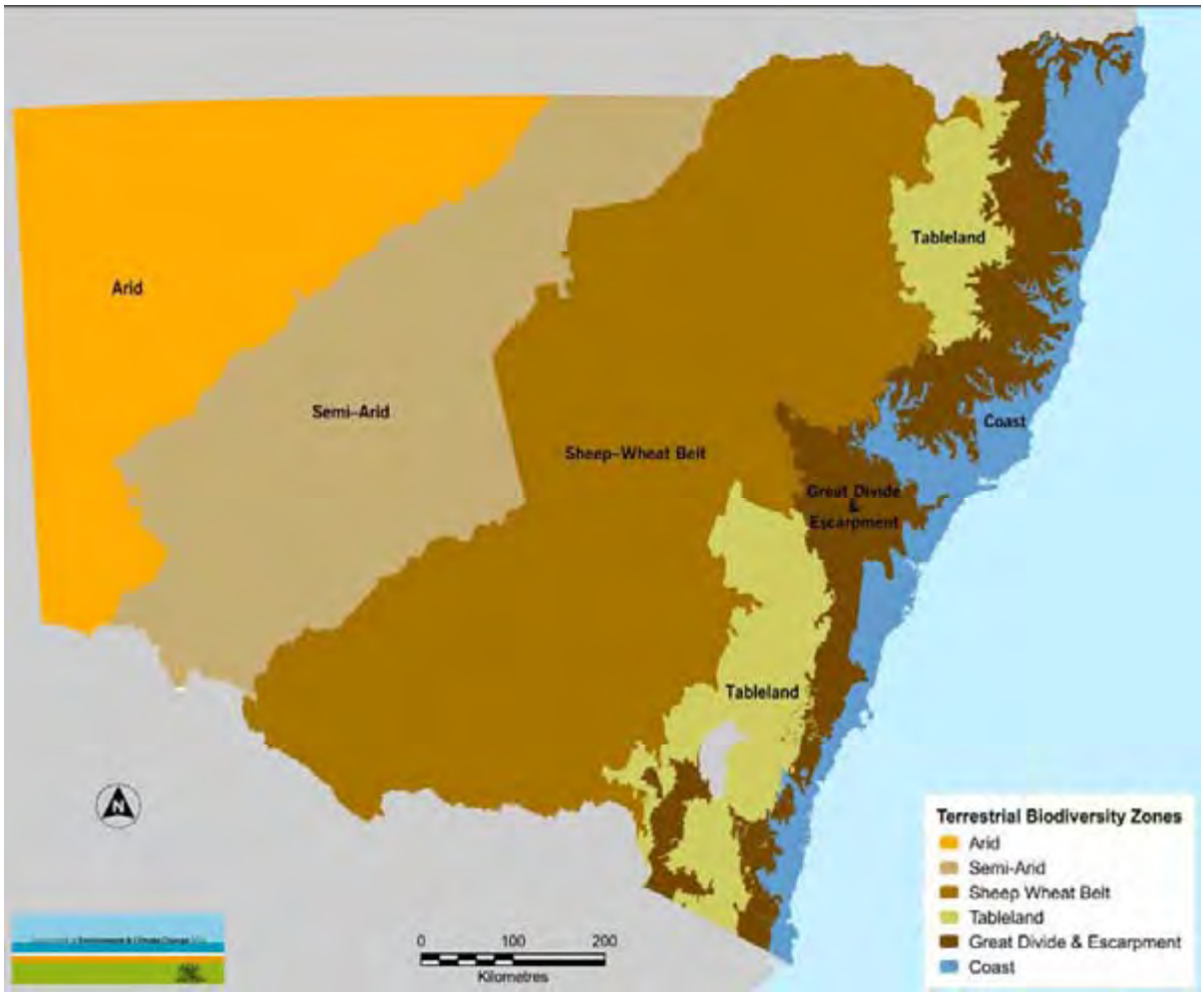
The status of terrestrial biodiversity is strongly influenced by past and current land uses. The discussion paper divides the State into seven zones which reflect the variation of land-use history, threats to biodiversity and conservation requirements at a very coarse regional scale (see Figure 1). These zones cross catchment boundaries because they group regions of the State according to their broadly similar threats and conservation needs.

The terrestrial chapter focuses on how to manage the legacy of past land uses and current major threats, using these zones as a starting point. The key threats identified for each zone are also identified.

To address the major threats, the discussion paper identifies objectives to:

- encourage and support the spectrum of sustained conservation actions across the landscape to address the legacy of past land management impacts
- control major current threats to terrestrial biodiversity.

Figure 1 NSW terrestrial biodiversity zones



Note: Coastal Urban Areas and Rural Growth Centres zone is too small to show at this scale.

Source: DECC GIS layer 2008

Freshwater aquatic biodiversity

Aquatic ecosystems support many species and provide valuable ecosystem services. Aquatic biodiversity is under threat from a number of major threatening processes, including alteration of natural flow patterns due to water extraction and river regulation, direct habitat loss and modification, invasive species and climate change.

To reverse the decline in aquatic biodiversity, the objectives proposed are to:

- effectively manage water resources and aquatic ecosystems to conserve biodiversity
- effectively manage fishing impacts on aquatic biota
- improve management at a catchment scale
- restore degraded habitats.

Marine and coastal biodiversity

The coastal waters of NSW have high biodiversity due to their wide range of oceanic, shoreline and estuarine habitats. Marine and coastal environments also provide many important ecosystem services. Current major threats to marine and coastal biodiversity include pollution and excessive nutrient levels, unsustainable use of resources, climate change, alterations of physical habitat and invasive species.

The discussion paper proposes that the strategy would address marine and coastal biodiversity decline with objectives to:

- integrate coastal zone management
- promote the adoption of sustainable fishing practices
- improve public knowledge and strengthen community involvement in marine and coastal biodiversity conservation initiatives.

Conservation and use of genetic resources

Genetic diversity within any species is necessary for its long-term viability and to maintain evolutionary potential. The genetic diversity of indigenous species needs to be conserved at the ecosystem, species and meta-population levels, and also by maintaining gene flows between populations and meta-populations.

The discussion paper identifies the need for an integrated policy for the sustainable management of genetic material in NSW. Proposed objectives for the conservation of genetic resources are to:

- develop an improved policy framework for sustainable management of endemic genetic resources
- maintain gene flow in fragmented landscapes
- develop improved information about and support techniques for conservation of microbial biodiversity
- maximise conservation of small and localised biodiversity, including local endemic plants, mosses, lichens, invertebrates and microbes
- establish and maintain a comprehensive *ex situ* conservation program.

Abbreviations

AQIS ..... Australian Quarantine and Inspection Service
CAP ..... Catchment Action Plan
CAR ..... Comprehensive, Adequate and Representative
CMA ..... Catchment Management Authority
CMN ..... Conservation Management Network
DEC ..... Department of Environment and Conservation NSW (now DECC)
DECC ..... Department of Environment and Climate Change NSW
DPI ..... Department of Primary Industries NSW
FM Act ..... *Fisheries Management Act 1994*
GER Initiative .. Great Eastern Ranges Initiative, previously referred to as the Alps to Atherton Initiative or A2A
ILUA ..... Indigenous Land Use Agreement
IPA ..... Indigenous Protected Area
IUCN ..... International Union for Conservation of Nature
MER ..... NSW Natural Resource Monitoring, Evaluation and Reporting Strategy
MPA ..... Marine Protected Area
NPW Act ..... *National Parks and Wildlife Act 1974*
NRM ..... Natural Resource Management
NRMMC ..... Natural Resource Management Ministerial Council, Australian Government
PAS ..... Priorities Action Statement
PNF ..... Private Native Forestry
PVP ..... Property Vegetation Plans
RCI ..... Regional Conservation Initiative
TSC Act ..... *Threatened Species Conservation Act 1995*
UNESCO ..... United Nations Educational, Scientific and Cultural Organisation

1. Setting the scene

What is biodiversity?

'Biological diversity' or 'biodiversity' is the diversity of all life on earth and consists of the following three components:

- genetic diversity – the variety of genes (or units of heredity) in any population
- species diversity – the variety of species
- ecosystem diversity – the variety of communities or ecosystems.

Biodiversity encompasses the complete range of life forms from the most obvious (such as birds, mammals and flowering plants) to the least obvious (such as soil microorganisms), many of which remain unknown to science.

Ecosystems are formed by the interaction of species with their environment, including such vital components as soil, water and nutrients. Less 'glamorous' species such as fungi and insects perform most of the ecosystem functions that are critical to the health of our natural, agricultural and urban environments. These species in turn are maintained by other species and ecological processes.

Because of their greater familiarity, the more 'charismatic' species, such as birds, mammals, fish and flowering plants, act as a flagship for the state of all biodiversity. While conservation tends to focus on these more notable species, it also needs to take account of the composition, structure and function of ecosystems (USDA Forest Service 1994).

Importance of Australia's biodiversity

Australia is one of fewer than twenty countries in the world recognised as 'megadiverse' (Commonwealth of Australia 2001). These megadiverse countries together hold two-thirds of the world's biodiversity. Australia has a high proportion of endemic species – those found nowhere else on earth.

The quality of life of present and future generations depends on conserving biological diversity and using natural resources sustainably. Protecting biodiversity helps maintain the services that ecosystems provide and which clearly benefit society in many ways. These include provision of clean water with its numerous benefits such as fisheries production; sustaining local and regional rainfall; controlling salinity; aiding pollination and the control of pests; maintaining soil structure, moisture and fertility; contributing to shelter, shade and lowered wind erosion; and helping to manage greenhouse gases.

Biodiversity also provides direct economic benefits such as tourism generated by iconic species such as koalas and whales and the benefits visitors to national parks bring to regional economies.

Many people in the community strongly support the protection of biodiversity because they believe that nature is intrinsically valuable, and a source of wonder and inspiration.


(J. Little)


(P. Meek)


(I. Shaw)

The respect of Aboriginal people for land and their cultural relationship to the natural world is a uniquely Australian recognition of the significance of biodiversity in all facets of life.

Need for a new Biodiversity Strategy for NSW

The NSW Government is committed through the State Plan, to a new Biodiversity Strategy as part of its 'Environment for Living' theme (NSW Government 2006). A new strategy would:

- establish common goals, principles and objectives for conserving biodiversity
- assist in the achievement of NSW natural resource condition targets
- guide investment decisions by individuals, community-based groups, industry and all levels of government through the development of regional priorities and agreed actions
- help the community understand, appreciate and value the State's biodiversity
- meet the State's national obligations.

Threatening processes

Governments around the world have acknowledged the scale of biodiversity loss and made a commitment to significantly reduce the rate of loss by 2010. Australia is a party to this global commitment as a signatory to the Convention on Biological Diversity. Efforts are underway in many countries to address the loss of species and habitats by identifying key threatening processes and adapting programs to reduce those threats.

(M.Lauder, DEC)

Among similar environments, larger areas of habitat generally have more species than smaller ones. As the area available to many species is reduced and fragmented, a cascade of losses occurs over long timeframes – centuries or even thousands of years. Because this is a very slow process compared to a human lifetime, the changes are often very difficult to grasp, but there is time to intervene and reduce the potential scale of loss (Rosenzweig 1999).

Loss and fragmentation of habitat through land clearing has generally been considered the greatest threat to biodiversity in Australia. In an effort to reduce its impact, NSW has taken significant steps to stop broadscale clearing. However, there are a number of other broad, interacting threats to biodiversity. These include invasive species, unsustainable levels of natural resource harvesting and extraction, pollution, and climate change (EPA 2000; Millennium Ecosystem Assessment 2005). Key threatening processes in NSW are listed in schedules to the *Threatened Species Conservation Act 1995* (TSC Act) and the *Fisheries Management Act 1994* (FM Act).

(Evolving Images)

(G. Robertson, DEC)

Biodiversity in NSW

NSW landscapes reflect a long history of Aboriginal management. These landscapes have changed significantly over the past 220 years following European settlement and this has resulted over time in significant changes to their biodiversity. More than 70 NSW species are now presumed extinct and over 1000 are listed as threatened. The great majority of those listed are from the best-known groups of species: birds, mammals and vascular plants. In addition, a number of key threatening processes have been listed under the TSC Act and the FM Act.

Despite extensive removal and/or modification of much of the State's natural resources, and the threats to our biodiversity, a rich and diverse natural heritage of native species and landscapes still remains. These range from alpine environments to wetlands, coastal and marine ecosystems to arid and semi-arid grasslands, woodlands, forests and rainforests. Some natural areas are recognised as globally significant. NSW has four World Heritage properties listed for their outstanding natural values and 11 wetlands declared under the Ramsar Convention (see Figure 2). The Great Escarpment is being considered for listing as a global biodiversity hotspot. Between 1995 and 2005 the area of Ramsar sites increased from 21,456 ha to 159,145 ha.

(P. Meek)

(P. Meek)

(P.Green, DEC)

Figure 2 Ramsar sites in New South Wales

Source: DECC GIS Layer 2008

Recent achievements in NSW

NSW Biodiversity Strategy 1999

The first NSW Biodiversity Strategy, published in 1999, significantly enhanced our knowledge and capacity and set the direction for many of the biodiversity advances achieved by the Government over the last decade. The strengths of the first strategy included:

- a commitment to the establishment of a comprehensive, adequate and representative ('CAR') reserve system
- the first bioregional biodiversity assessments
- support for the contribution of local government to protecting biodiversity
- progress on vegetation classification and mapping
- expansion of cooperative approaches to weed and pest management
- greater understanding of fire ecology as a basis for managing reserves and other natural areas.

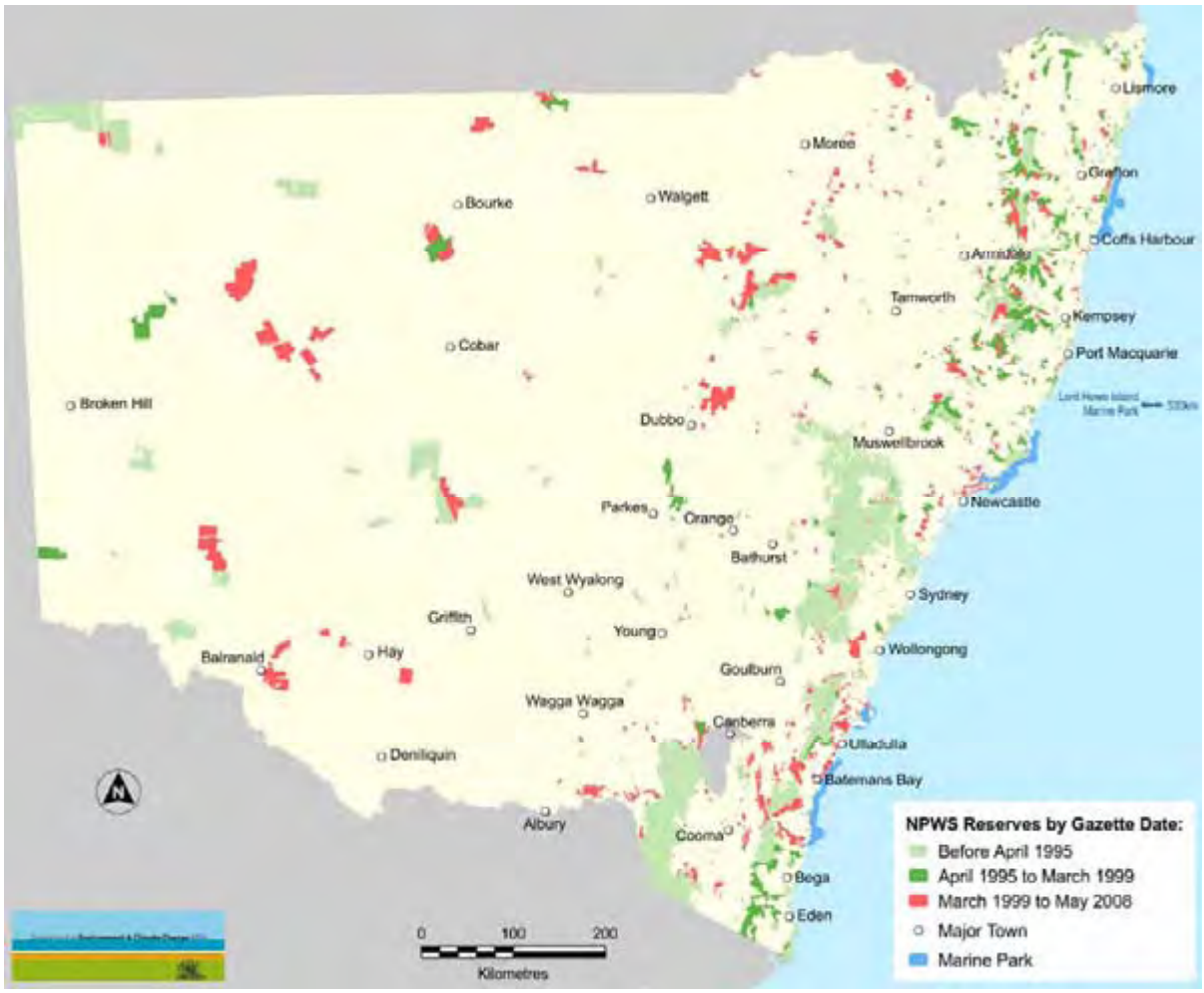
Reserve system expansion and management

The NSW reserve system has expanded from 4 million hectares in 1995 to more than 6.5 million hectares, or 8.5% of the State (see Figure 3). Over the same period, declared

wilderness increased by 1.24 million hectares. The gains include over 1 million hectares of coastal forests and 1.3 million hectares in the poorly reserved far west and sheep–wheat belt. A highlight was the reservation in 2005 of nearly 352,000 ha of woodlands and forests in the under-represented Brigalow Belt South and Nandewar bioregions.

In 1995, NSW had no marine parks. Six marine parks have since been declared, including two in 2006 centred on the Port Stephens–Great Lakes and Batemans–Narooma areas (see Figure 10 in Chapter 11).

Figure 3 Growth in the NSW reserve system since March 1995



Source: DECC National Park Estate GIS layer, August 2008

Natural resources and catchment management

Coordinated catchment management is a critical strategy for protecting biodiversity as part of a broad natural resources management approach. The NSW Government has established Catchment Management Authorities (CMAs) and the Natural Resources Commission to drive natural resource management planning and implementation. As part of this initiative, NSW has adopted statewide targets for the condition of key natural resources, including biodiversity (see box below). A quality management standard to guide planning and investment has also been established. These targets include themes for biodiversity (native vegetation, invasive species, threatened species and fauna) and water (rivers, wetlands and marine ecosystems).

Key statewide natural resource condition targets for biodiversity, water and land

Biodiversity

Macro-environmental

1. By 2015 there is an increase in native vegetation extent and an improvement in native vegetation condition
2. By 2015 there is an increase in the number of sustainable populations of a range of native fauna species

Specific priorities

3. By 2015 there is an increase in the recovery of threatened species, populations and ecological communities
4. By 2015 there is a reduction in the impact of invasive species

Water

Macro-environmental

5. By 2015 there is an improvement in the condition of riverine ecosystems
6. By 2015 there is an improvement in the ability of groundwater systems to support groundwater-dependent ecosystems and designated beneficial uses
7. By 2015 there is no decline in the condition of marine waters and ecosystems

Specific priorities

8. By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained
9. By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems

Land

Macro-environmental

10. By 2015 there is an improvement in soil condition

Specific priorities

11. By 2015 there is an increase in the area of land that is managed within its capability

Source: NSW Government 2006

Statewide performance indicators to quantify change in the condition of these natural resources will be used for periodic reporting over the 10-year term of the Catchment Action Plans (CAPs) being developed by the CMAs. These indicators will also be adopted for future State of the Environment reporting in NSW. The indicators will inform natural resource management monitoring and evaluation of both resource condition and program performance and will also enable reporting on implementation of this strategy.

Threatened species conservation

The TSC Act and Part 7A of the FM Act were introduced to provide a legislative framework for the conservation of both terrestrial and aquatic biodiversity that are under significant

threat in NSW. Local land-use and natural resource planning and development consent processes now incorporate consideration of the impact of rezoning and development proposals on threatened species, populations and ecological communities. A range of recovery actions have been agreed to and adopted for many species, including the Wollemi pine and the koala. Threat abatement plans are also being implemented for key threatening processes, such as foxes and bitou bush.

Significant reforms in 2004 to the threatened species legislation introduced the principle of the net maintenance or improvement of biodiversity through certification of planning instruments. The reforms provided for the establishment of a biodiversity banking and offsets scheme, or biobanking scheme. These reforms also established the use of the Priorities Action Statement (PAS) under the TSC Act and the FM Act to provide a regular comprehensive public guide to recovery and threat abatement strategies and actions. The first PAS was published in 2006 and over time it will be used to assess and report on the effectiveness of actions in achieving the recovery of threatened species and abatement of key threatening processes (DEC 2006a). The amendments to the legislation also introduced clear criteria to guide the independent Scientific Committees in decisions on listings under both Acts.

Native vegetation

The *Native Vegetation Act 2003* was introduced as part of an historic environmental commitment to end broadscale clearing of native vegetation in NSW and enable the Government and landholders to focus on restoring landscapes, leading to the recovery of threatened species and their habitats. The methodology for assessing applications for broadscale clearing protects native vegetation types and landscapes which have been over-cleared.

A central feature of the new legislation, which came into effect in December 2005, is a system of negotiated agreements between landholders and their local CMA, known as Property Vegetation Plans (PVPs). The Act requires landholders to maintain or improve environmental outcomes on any part of their land covered by a PVP. In 2006, only 3650 ha were approved for clearing under the Act. In mid-2007, amendments to the *Native Vegetation Regulation 2005* introduced the Private Native Forestry PVPs and Code of Practice, which regulate forestry operations on private land. As of May 2008, 382 PNF PVPs have been approved, resulting in regulation of the use of 112,000 ha of vegetation.

A key principle of the reforms is the need for continuous improvement of the system as new information becomes available, based on the best scientific advice. This will ensure an adaptive management approach to native vegetation under the new laws. Recently, a first set of improvements reinforced the ‘improve or maintain biodiversity’ test while ensuring it is specific to each individual region and based on the best available science. This has led to improvements in the way invasive native species (often referred to as ‘woody weeds’) are managed under the PVP system, allowing farmers and CMAs more flexibility while continuing to meet the key aims of the Act.

Water

The *Water Management Act 2000* provides for secure water entitlements, bringing a more stable business environment and an opportunity to use the market to buy water for the environment. An important aim of the National Water Initiative is to return water extraction in overused systems to environmentally sustainable levels. In NSW, Water-sharing Plans are making an important first step towards this objective and NSW has committed $150 million for water recovery for the Snowy and Murray Rivers under the Snowy Corporatisation agreement.

The degradation of both inland and coastal wetlands has been addressed in several ways, including public reservation. NSW RiverBank is buying water for our most stressed and

valued rivers and wetlands over the five years from 2006 to 2011. NSW has allocated over $100 million and attracted additional funding of over $70 million from the Australian Government for this initiative. RiverBank marks the first time an Australian government has entered the water market to acquire water on behalf of the environment and is a significant step in increasing the volume of environmental water. NSW has also committed $115 million to the Living Murray initiative, which aims to recover 500GL of water for six icon sites on the Murray River. NSW and the Australian Government are also each contributing $13 million to the Gwydir Wetlands and Macquarie Marshes under the NSW Wetland Recovery Program.

A number of significant assessment and infrastructure management initiatives are being undertaken by the State Water Corporation and other water utilities, in conjunction with government agencies. These include a response to managing outbreaks of algae and the NSW Cold Water Pollution Strategy, which seeks to mitigate the impact of cold-water releases from high-level dams in many of our rivers and gradually restore the fish and other aquatic biota in the ecosystems downstream.

Forestry

The *National Forest Policy Statement 1992* initiated a major review of the management of public forests in Australia (Commonwealth of Australia 1992). In NSW, regional forest assessments have led to a major expansion of forest reserves and the adoption of regulatory provisions to achieve ecologically sustainable management of forests used for public production.

World Heritage

The Blue Mountains was added to the World Heritage list in 2000 in recognition of its internationally significant natural values. NSW is also participating in the assessment of the national heritage values of the Australian Alps.

Climate change

Climate change is already affecting our biodiversity. Research and planning is under way into measures to adapt to the changes and reduce the loss of environmental values and maintain the resilience of ecosystems. Through its *Biodiversity and Climate Change Adaptation Framework* and the *Department of Environment and Climate Change NSW Adaptation Strategy for Climate Change Impacts on Biodiversity (2007–08)*, NSW has committed to making a significant effort to implement the *National Biodiversity and Climate Change Action Plan 2004–07* and funded research into the impacts of climate change on biodiversity and ways to ameliorate these under the *NSW Greenhouse Plan 2005* (NSW Greenhouse Office 2005). NSW is committed to developing a Climate Change Action Plan, which will set priorities for adapting to climate change.

Salinity

The *NSW Salinity Strategy* (DLWC 2000) recognised the threat posed by salinity to biodiversity and, in particular, initiated preliminary assessments of the impacts of dryland salinity on native vegetation. Salinity continues to be a major land degradation issue in NSW though a new understanding of it may lead to a reassessment of its potential future extent. Climate appears to be the major driver of dryland salinity processes and its expression in the landscape.

Remediation efforts are having some success, particularly in irrigation areas and some areas affected by dryland salinity, but progress is slow because of its wide extent and the slow pace of remediation (DEC 2006b).

Conservation funding

NSW has invested significantly in a range of substantial programs to secure biodiversity outcomes. Some of the more notable programs include:

- $8.5 million on implementing the first NSW Biodiversity Strategy
- $370 million in 2008–09 to manage the park system
- $115 million to the Living Murray project to restore flows to high-conservation-value wetlands
- $105 million for RiverBank to purchase water for the environment
- $13.4 million through the NSW Wetland Recovery Program to restore the Gwydir Wetlands and Macquarie Marshes
- $13 million to purchase Crown leases from willing sellers
- $120 million for the retention and restoration of native vegetation through CMAs as part of their catchment action plans.

2. A new Biodiversity Strategy for NSW

A new Biodiversity Strategy for NSW is proposed, with a 20-year time frame. It would build on current government and community efforts with the aim of significantly slowing the rate of biodiversity decline and supporting progress towards achieving the NSW natural resource condition targets. These are important goals in the NSW State Plan (NSW Government 2006). The strategy should also promote strategic program development and coordination across all levels of government, industry and the community, as well as across the whole landscape, leading to agreed initiatives to conserve regional biodiversity and minimise threats to its future. It should also improve the way in which priorities are set and investment decisions are made.

(J. Denby)

(NPWS)

Statutory framework for the draft NSW Biodiversity Strategy

The NSW Biodiversity Strategy is a statutory requirement under section 140 of the *Threatened Species Conservation Act 1995* (TSC Act). The Act gives joint responsibility to the Directors-General administering the TSC Act and the *Fisheries Management Act 1994* to prepare or review the Biodiversity Strategy. The purpose of the strategy is to set out how the objects of the TSC Act are to be achieved for terrestrial, aquatic and marine biodiversity.

TSC Act, Section 140:

(2) The strategy is to include proposals for:

(a) ensuring the survival and evolutionary development in nature of all species, populations and communities, including appropriate protection under the *Wilderness Act 1987* or the *National Parks and Wildlife Act 1974* or under the *Fisheries Management Act 1994*, and

(b) preparing or contributing to the preparation of strategies for ecologically sustainable development in New South Wales, including the integration of biological diversity conservation and natural resource management, and

(c) an education program targeted at the community and public authorities, and

(d) a biological diversity research program, and

(e) encouraging greater community involvement in decision-making affecting biological diversity.

(3) The strategy must also include:

(a) the objectives and performance targets of the strategy, and

(b) a statement of the means by which these objectives and performance targets are to be achieved, and

(c) a statement of the manner in which the National Parks and Wildlife Service constituted by the *National Parks and Wildlife Act 1974* and NSW Fisheries propose to assess their performance with respect to attainment of the objectives and performance targets of the strategy.

The following goals, principles and objectives are proposed for possible inclusion in a new Biodiversity Strategy.

Goals for a new strategy

Future species diversity depends on the amount, diversity, spatial arrangement and condition of ecologically effective habitat we retain and restore at all scales. Given commitment, time, resources and knowledge, it is possible to recover many threatened species and ecological communities and protect much of our biodiversity into the future. A long-term commitment and perspective are needed. Many different timeframes could be established. The proposed goals for the strategy include the NRM targets for 2015, a 20-year biodiversity goal for 2025 and a 100-year vision. The NSW natural resource management (NRM) resource condition targets will make a significant contribution to these goals over the next decade.

2015 targets

By 2015, the NRM resource condition targets for biodiversity and water and the recovery of threatened species, wildlife and important ecosystems will have been achieved, and critical measures to reverse long-term biodiversity decline instigated.

20-year goal

By 2025, sustained and successful efforts by the whole community to control the threats to biodiversity will have led to more widespread recovery and increasing connectivity across NSW landscapes, with viable and diverse ecosystems and species' assemblages that also contribute to sustainable regional communities and economies.

100-year vision

Within the next century, the effects of climate change on biodiversity will have been minimised through measures to maintain and restore diversity and resilience to natural ecosystems and agricultural landscapes, so that ecological change does not equate to loss of diversity.

Guiding principles for biodiversity conservation

Guiding principles are also useful in any long-term strategy and these could include:

- Biodiversity is best conserved *in situ* (that is, in its natural environment) and at all levels: genetic, species and community.
- Maintaining the integrity, dynamics and resilience of natural systems is critical to their functioning.
- Government at all levels should follow the principles of ecologically sustainable development, in particular the intergenerational equity and precautionary principles.
- Habitat connectivity is vital at regional and continental scales, as well as at local scales.
- Priority-setting for biodiversity conservation actions should take account of the vulnerability of conservation values to the loss of biodiversity over time.
- Prevention of loss and degradation of biodiversity habitat is the first priority and is significantly more cost-effective and less risky than recovery and restoration actions.
- The importance of biodiversity to Aboriginal culture and the value of Aboriginal people's contribution to conservation are recognised and supported.
- The establishment of a comprehensive, adequate and representative reserve system and sustained conservation across the whole landscape are both central to biodiversity conservation.

We are interested in your views and comments on the appropriateness of these goals and guiding principles.

Objectives

Each chapter in this discussion paper identifies strategic objectives, each with a number of key directions for actions that could make a significant contribution to meeting the objective. The key directions are designed to generate discussion about how best to achieve the identified goals and objectives.

We are interested in your comments on the range of objectives identified in later chapters.

Implementation, monitoring and evaluation

The proposed objectives and key directions in a new Biodiversity Strategy would be given effect through State Government programs, including those that seek to engage other organisations and community groups. They would be implemented with regard to social and economic factors. Information about major biodiversity programs would be linked to a revised Biodiversity Strategy website.

There will be regular reporting on the biodiversity-related targets and milestones identified in the NSW State Plan (NSW Government 2006). In addition, the Government has adopted a Monitoring, Evaluation and Reporting Strategy for NRM which will assess progress against the natural resource condition targets, including those with biodiversity components. State of the Catchment and State of the Environment reports will also report on biodiversity.

DECC and the Department of Primary Industries (DPI) will prepare strategy implementation reports for the Government from time to time. Consideration will be given to holding periodic public forums for a broad range of stakeholders to consider implementation in more detail.

Strategy implementation reports would cover:

- changes in biodiversity status over time, including the effects of management actions on the ground
- the effectiveness of conservation program design and coordination at the regional scale in addressing regional conservation priorities
- the effectiveness of State biodiversity policy and programs including information, capacity and funding
- gaps and any impediments to the uptake of strategic directions for change identified in the strategy.

We are interested in your comments on effective ways of reporting on implementation, monitoring and evaluation for the Biodiversity Strategy.

3. Strategy fundamentals

This chapter identifies the statewide programs and institutional arrangements that affect biodiversity and possible changes to enhance biodiversity outcomes.

Improved decision-making

Regional programs and priorities

The recent reforms to natural resource management (NRM) in NSW seek to improve the flow of information and the quality of decision-making and priority-setting at regional scales, to achieve state and regional natural resource condition management targets. The NRM reforms also aim to promote greater integration of planning, implementation, monitoring and reporting efforts at the catchment scale. Despite these moves towards collaborative effort, roles and responsibilities are not always clear or aligned and some activities have not made the best use of available investment resources at State or cross-catchment/cross-sector scales.

Some of the major threats to biodiversity operate at very large scales, reflecting broad ecological patterns and processes. There is a long history of recognition of some large-scale issues in natural resource management, as reflected in the establishment of the Murray–Darling Basin Commission and the even earlier creation of the Western Division. Building of the reserve system has traditionally taken place within the larger bioregional framework. Efforts to manage invasive species and fire are increasingly moving beyond the site scale to the landscape scale. These NRM and biodiversity conservation frameworks already recognise that the management of natural resources or plants and animals does not necessarily accord with established administrative boundaries.

An overarching aim of the new Biodiversity Strategy would be to support better integration and alignment of the efforts of all parties involved in conservation planning, priority-setting and program design and delivery. This will be essential if the NSW natural resource condition targets are to be achieved.

Regional Conservation Initiatives

An agreed ecological planning framework is needed to integrate efforts across different scales and provide a vehicle for effective decision-making about competing, as well as complementary, priorities. A series of ‘Regional Conservation Initiatives’ (RCIs) is proposed to integrate and align the programs run by the State Government (including CMAs), local government and the non-government sector, to give effect to the NSW State Plan. The RCI program would be an iterative process of adaptive management producing on-ground biodiversity outcomes. RCIs involve a conservation strategy, the engagement and collaboration of partners and the development of an agreed package of actions to be incorporated into existing partnerships and programs.

Each RCI will:

- integrate the full range of biodiversity programs (threatened species recovery; threat abatement planning; reserve and protected area establishment and management; pest and weed management; climate change adaptation) so they contribute to priorities for connectivity within and between regions
- provide guidance to agencies, industry, CMAs and others on how to consider large-scale ecological processes and threats in similar landscapes as part of a wider coordinated effort
- help Government coordinate its support of implementation of Catchment Action Plans and other land-use planning and management including public land management

- deliver the regional objectives of the Biodiversity Strategy in partnership with other Government programs, while avoiding duplication of the significant efforts underway through CMAs and other organisations
- track progress in uptake of agreed action commitments and identify opportunities for improved efficiency and cost-effectiveness in addressing common objectives and priorities.

The benefits of this approach include progress in achieving:

- regional, including catchment, and continental-scale habitat connectivity
- development of an adaptive framework for the large north-south and lowland-upland range shifts associated with climate change
- application of best-practice biodiversity conservation management across administrative boundaries
- better complementarity between public and private conservation initiatives
- reduced risk of poor investment choices
- pooled resources and economies of scale, including shared information and data-gathering
- agreed overall outcomes, to which finer-scale decisions, including the application of market-based instruments, can contribute.

RCIs will involve a review of current programs and actions, identification of priorities and development of an agreed package of actions which integrate:

- on-ground action across tenures
- data-gathering and research
- community engagement and capacity building
- policy and program development.

The boundaries of the proposed RCIs need to take account of both ecological and socio-economic considerations. A possible starting point could be to base the RCIs on the landscape zones described in Chapter 9. These zones are based on land-use history and threats and are large enough to be relevant to planning for climate change adaptation. They also offer the potential to bring together those parts of bioregions and catchments with similar types of assets, threats and needs. Of course, fine scale planning will still be necessary in many circumstances: in-stream biodiversity, for example, may be best addressed at the catchment scale. In addition, urban and rural growth areas are already the subject of fine scale conservation planning. Each RCI will provide guidance on the best approach to finer scale planning and priorities within the RCI area.

Each RCI is proposed to provide a package of actions, developed in accordance with a technical manual, to conserve important biodiversity assets and control significant threats across tenures. They would be implemented through better coordination of existing or new programs by CMAs, local councils, agencies, industry groups and community organisations, with an agreed understanding of the contribution each would make to the wider effort. A rigorous and consistent process would develop priority actions that make the greatest biodiversity gains in line with State and national targets and opportunities.

RCI development will be a collaborative effort involving other NSW Government agencies, CMAs, local councils, industry and community groups, and will reflect the roles and expertise of each. Consolidating existing knowledge and partnerships and reducing duplication of effort will be emphasised.

By identifying priority actions in the larger context of State priorities and large-scale zones with broadly similar environments and threats, it is proposed that RCIs will promote consistent knowledge-transfers between decision-makers and across the wider community.

Great Eastern Ranges Initiative

The Great Divide and Escarpment Zone (see Chapter 9) contains two World Heritage properties and two Ramsar wetlands, as well as 59% of the State's vulnerable and endangered flora. The zone is being evaluated for possible nomination to Conservation International for listing as a global biodiversity or wilderness hotspot. Separately, the Australian Alps (also part of the zone) is being nominated for National Heritage listing under federal legislation.

The zone is the NSW section of the Great Eastern Ranges (GER) Initiative which extends along parts of the Great Divide and most of the Great Escarpment of eastern Australia. This continental-scale 'lifeline' of natural ecosystems has provided microclimates and refuges for a shifting abundance of native species over millions of years and includes a living fossil: the endangered Wollemi pine.

The GER concept aims to increase the resilience of protected areas, including reserves, by increasing opportunities for ecosystems and species to adapt and move between the large number of national parks and other public and private lands. An RCI connectivity management framework is proposed as the vehicle to promote the initiative. This would involve collaborative cross-tenure management of habitat and restoration activities, as well as integrated management of pests, weeds and fire, guided by the best available science.

RCIs will be packaged differently depending on the varying needs of different parts of the State. The unique nature of landscapes in the GER Corridor and the opportunities provided by current land-use patterns and management programs mean that the GER Initiative is well placed to address RCI objectives for this part of the State.

We are interested in your views on the concept of Regional Conservation Initiatives. In particular, we would like to hear from you about the advantages and disadvantages of different scales and boundaries, and the value of RCIs for improving integration and focus and ensuring that public and private investment in biodiversity conservation is directed to priority actions in the most suitable locations.

We would appreciate your views on how best to involve landholders and local communities, including Aboriginal communities.

The development of a new Biodiversity Strategy involves public exhibition of a draft strategy. Should the proposed RCIs be publicly exhibited at the draft stage?

Improved priority-setting

To give effect to the 2006 NSW State Plan environment theme, State agencies will work with Catchment Management Authorities and other partners to improve the identification of regional biodiversity conservation priorities.

There will undoubtedly be a need to make some hard decisions about what our priorities are and where the best biodiversity outcomes will be achieved with the resources we have. Loss of some components of biodiversity seems inevitable, given the costs and the technical impossibility of protecting everything. We need not only to identify and protect the critical ecological infrastructure[1] that maintains viable populations of native species at the landscape

[1] 'Critical ecological infrastructure' means sufficient diverse habitat in good enough condition and well-enough connected across the landscape to maintain critical ecosystem processes and the ecological functions that underpin the delivery of ecosystem services to society (Dominic Sivertsen, DNR, pers. comm.).

scale, but also to critically assess the long-term viability of populations and habitats at greatest risk of decline and the feasibility of protecting them, to target investment wisely and avoid wasted effort and resources. Better knowledge of critical thresholds will be required than is currently available for many ecosystems. CMAs and other regional decision-makers are grappling with the need to improve priority-setting for conservation investment. State and cross-regional efforts must likewise grapple with how to make difficult choices and trade-offs at these scales and how to assist regional and local partners to implement these priorities at catchment and finer scales. The RCI model will assist in this regard.

The strategy must emphasise the importance of priority-setting which will contribute cost-effectively to two outcomes:

- securing biodiversity components (that is, species or ecosystems) not already represented in secure conservation management tenures, prioritised on the basis of irreplaceability, critical functionality, vulnerability and site-level viability
- securing for each component an adequate extent, abundance and suitable spatial configuration at a landscape scale within NSW to give confidence about its long-term viability, genetic diversity and evolutionary potential.

Priorities should be assessed in terms of:

- the benefit over time of a proposed action
- the comparative benefits of alternative courses of actions
- the ratio between the benefit predicted from a choice of actions and their cost of implementation
- the risk of failure, particularly where restoration is involved.

There is scope to improve the amount of biodiversity conserved per dollar spent (Possingham *et al*. 2002). A greater ability to quantify the relationship between the scale and cost of action and the biodiversity benefit gained is also desirable and will provide an overall strategic context for decision-making and public investment (Pannell in press). Decision-support tools that take account of the inherent complexity and interactions of natural systems are becoming increasingly important.

Mechanisms to promote integrated conservation across public and private land

Historically, conservation has largely been focused on the property scale. This is changing to a landscape focus, which brings with it a need to seek outcomes across property boundaries and different tenures.

New mechanisms are being developed for landscape-scale conservation in lands modified for production but which still retain important natural values and where management of threats to biodiversity is vital. In 2005 the NSW Government established a formal multi-tenure landscape conservation model through the first multiple category reserves in the Brigalow Belt Community Conservation Area.

Additional landscape conservation area approaches that integrate conservation and sustainable production may be achieved through the voluntary involvement of private land, such as conservation stewardship. Further development of cost-effective long-term management arrangements for small dispersed sites of conservation significance would be useful, especially where biodiversity management and habitat restoration is complex.

An innovative regulatory environment

Legislation and regulation to facilitate the effective integration of biodiversity requirements into land-use and natural resource management are important conservation tools. They can define conservation policy goals, establish relevant processes and control major threats to biodiversity.

The NSW regulatory framework for biodiversity conservation, land-use planning, protection of the environment and natural resource management has improved significantly over the last ten years without compromising economic and social goals. For example, all major commercial fisheries regulated under the *Fisheries Management Act 1994* (FM Act) have been formally assessed through Environmental Impact Statements and controlled by Fishery Management Strategies. It is also standard practice to seek continuous improvement in legislation and regulation to ensure that stated objectives are being realised and costs and benefits are equitably, efficiently and effectively distributed. This has been a consistent direction of Government reforms.

The use of market-based instruments, such as BioBanking, will increasingly support and enhance regulatory efforts.

BioBanking

The NSW Biodiversity Banking and Offsets Scheme ('BioBanking') will provide a market-based framework for conserving biodiversity. The scheme, which commenced on July 1 2008, aims to reduce cumulative biodiversity losses caused by population growth and development pressures around urban areas, along the coast and at major inland development sites.

BioBanking provides a framework for offsetting the impact on biodiversity from development at one site through positive management actions at another site, provided that overall biodiversity values are improved or at least maintained. The scheme gives developers the option of obtaining a BioBanking statement if their development meets this 'improve or maintain' test. The statement sets out the number and class of biodiversity credits they need to purchase and retire for the development. These biodiversity credits must have been generated by biobank sites that have the same threatened species or ecological community as those being affected by the development.

Landowners can also establish a biobank site on their land under a BioBanking agreement and generate credits they can sell. The sale of credits will provide funding to carry out management actions for the ongoing protection and enhancement of biodiversity values at the site. The scheme provides that outcomes cannot be affected by change of land ownership as BioBanking agreements will be registered on the land title and exist in perpetuity.

The BioBanking assessment methodology will be used to determine the number and type of credits which must be purchased to offset the impacts of a development and the number and type of credits which can be generated by landowners who enter BioBanking agreements.

Initially, participation in the scheme will be voluntary. Developers who do not obtain a BioBanking statement will still need to comply with current threatened species assessment requirements.

Future directions may include:

- consideration of potential applications of Biobanking to the *Native Vegetation Act 2003*
- identification of priority landscapes for a range of conservation investments.

Targeted investment in biodiversity

Securing cost-effective outcomes

The public and private costs and benefits associated with retaining or losing biodiversity are being increasingly recognised in decision-making. This requires improved estimates of the costs of conservation and finding the most cost-effective ways of achieving outcomes.

Some comparative assessments are available on the effectiveness of a range of conservation actions compared with their cost. In one study (Environment Australia 2001), the actions that had the greatest value in terms of species secured per million dollars spent and the highest collateral cost/benefit ratio in terms of ecosystem services were:

- protecting the health of the least disturbed rivers (see Chapter 10)
- biological control of vertebrate pests (see Chapter 8)
- consolidating the national reserve system (see this chapter)
- eradicating new outbreaks of plant species with weedy potential (see Chapter 8)
- managing grazing for conservation in threatened grasslands in south-eastern Australia (see Chapter 6)
- implementing fire management regimes in native vegetation which promote a diversity of fire patterns (see Chapter 9).

Of the range of actions assessed, the next highest benefits for species would be obtained by preventing broadscale clearing of high ecological value communities or communities in the Murray–Darling Basin with high multiple ecosystem service value, limiting the spread of Phytophthora and biological control of weeds of national significance. These also had high collateral benefits.

While investing in retention of biodiversity is demonstrably more cost-effective and less risky than restoring or re-establishing habitat and recovering threatened populations, once the damage has been done, repair as well as retention are required.

Principles to guide investment in biodiversity conservation include:

- clear priorities must be set
- cost-sharing arrangements should equitably reflect the public and private costs and benefits
- levels of investment should be adequate for the purpose
- monitoring of outcomes from the investment is essential.

Public investment directed to priority actions

The current level of government investment in biodiversity across Australia is substantial and NSW is committed to working with the Commonwealth to ensure that national funding programs, such as Caring for our Country, address the State's biodiversity priorities. If most of our remaining species and unprotected ecosystems are to be conserved in the long term, a gradual but significant increase in the area of land managed for biodiversity and the volume of environmental flows in our rivers will be needed over the coming decades. A long-term investment framework will reduce the risk of short-term investments not being effective or sustained over time.

Traditional reliance on government funding is being augmented by a wider array of funding mechanisms to foster conservation. These include competitive access to public funding, levies on certain activities such as urban development, and incorporation of conservation provisions into structural adjustment and industry support packages. In certain contexts, cost-effective outcomes can be achieved by providing a reliable, relatively low-cost, supplementary income stream to landholders who contract to change their production methods, control threats and meet certain standards of habitat condition over a number of years.

Ongoing commitment to traditional conservation programs

The reserve system

The central role of conservation reserves in implementing the objectives of the Convention on Biological Diversity is internationally accepted (see, for example, Ecological Society of Australia 2003). NSW is building a reserve system that strives to be comprehensive, adequate and representative (known as 'CAR'). The adoption of CAR principles results from a number of national initiatives, including the National Strategy for the Conservation of Australia's Biological Diversity (DEST 1996) and the Directions for the National Reserve System statement (NRMMC 2005).

Figure 3 (in Chapter 1) shows the current extent of the terrestrial reserve system protected under the *National Parks and Wildlife Act 1974* (NPW Act). Other components of the reserve system in NSW include flora reserves under the *NSW Forestry Act 1916* and Crown reserves dedicated specifically for fauna or flora. The *Fisheries Management Act 1994* provides for the establishment of aquatic reserves and the *Marine Parks Act 1997* for the establishment of marine parks. Marine protected areas (MPAs) in NSW include marine parks, marine components of national parks and nature reserves, and aquatic reserves (NSW Government 2001). MPAs are increasingly being used around the world as a major tool to conserve marine biodiversity, protect marine habitats, and ensure the sustainability of harvest fisheries (Creese & Breen 2003). Figure 10 (in Chapter 11) shows the distribution of marine protected areas along the NSW coast.

Public reserves allow for sizeable areas of habitat to be permanently conserved in rapidly changing landscapes, which is rarely possible through less secure conservation means. Other benefits include:

- legal protection in perpetuity
- transparent investment of public funds
- public accountability for reserve management
- highly skilled management of reserves using the best scientific expertise
- community participation
- social, recreational, cultural and economic benefits
- contributions to catchment biodiversity targets.

Reserve planning takes account of ecological communities which are currently poorly represented, as well as important landscape corridors and linkages. Additions to the reserve system aim to be cost-effective contributions to reducing the decline of biodiversity. Future national park establishment in NSW will be in accordance with the recently adopted *NSW National Parks Establishment Plan* (DECC 2008).

NSW State of the Parks 2004 (DEC 2005) was the first comprehensive report on the management of the NSW reserve system. It found that in over two-thirds of the reserve system most natural values are in good condition and their integrity is not at risk.

Recent improvements in reserve management, such as pest and weed control and managing fire, need to continue. Also, some lands which come into the reserve system are vulnerable to threats as a consequence of past land use. The Fox Threat Abatement Plan (NPWS 2001) is an example of how to successfully identify and target priority species and habitats within the reserve system. It is important that declining and threatened species, populations and ecological communities which rely on reserves are secure in them. Reserves should ideally provide the benchmark of intact landscapes, retaining their biodiversity and providing conservation, cultural, recreational and educational benefits.

Protected areas outside the reserve system

Other protected areas[2] outside public conservation reserves make an important contribution to biodiversity protection. They are generally found on private or leasehold land, including those established by conservation organisations. These areas may also be protected through NSW or Commonwealth conservation covenants and able to attract federal establishment funding. Currently, some 20,000 hectares is protected through conservation covenants under the NPW Act.

Conservation covenants can also be part of the CMA Property Vegetation Plan (PVP) process and other biodiversity investment programs. They may also be eligible for rate and tax concessions. In 2006, over 31,000 hectares was protected in PVPs under the *Native Vegetation Act 2003* and nearly 4000 ha were protected as offsets. Another 62,000 ha is protected in perpetuity through registered property agreements under the former *Native Vegetation Conservation Act 1997* (now repealed), with another 20,000 ha protected through property agreements and management contracts which typically run for 10–20 years. There are also more than 20,000 ha of Travelling Stock Reserves protected under management contracts. CMAs now administer these agreements.

Other mechanisms also engage landholders in conservation. These vary in the level of security and commitment involved. Currently, more than 630 wildlife refuges, covering over 1.9 million hectares, have been gazetted under the NPW Act. Some 10% of this is estimated to be exclusively managed for conservation, with integrated conservation and production on native grasslands and woodlands over most of the rest of the properties. Wildlife refuges are not formally protected areas as their gazettal can be rescinded at the landholder's request, although in practice, this has occurred in only a handful of cases.

In some highly cleared landscapes, public lands such as cemeteries, travelling stock routes and utility corridors, hold regionally significant biodiversity values. A range of voluntary mechanisms can be used to protect these areas, including conservation covenants.

It is proposed that expansion of the protected area network outside the reserve system will target such conservation priorities as:

- extensive natural areas which retain significant conservation values
- ecosystems poorly represented in the formal reserve system
- core habitats of threatened species, populations or endangered ecological communities
- areas providing refuge from drought and climate change
- formal protection of a minimum 5% representative sample of the original extent of highly cleared (> 70%) vegetation communities (endangered ecological communities) where possible
- areas adjacent to reserves with potential to complement reserve management and manage threats at the landscape scale
- conservation management of important ecological corridors to enable native species to move across their current and future ranges
- important inland and coastal wetlands and floodplains
- areas of recognised state, national or international biodiversity significance.

Proposals to promote greater engagement by landholders are outlined in Chapter 6.

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[2] 'Protected areas', including reserves, are areas securely protected and managed for conservation in accordance with IUCN management categories. Other areas may be managed for conservation and make an important contribution to conservation across the landscape, but lack this level of long-term security.

Danabilla–Illunie Range Protected Area Network

One example of the development of a regional protected area network is in the Danabilla–Illunie Range in the Young–Cowra–Boorowa area of the south-west slopes. The network so far links four nature reserves with conservation areas on private lands, five of which have conservation covenants in place, while others are being negotiated. Corridors between remnants are also being established.

Together, the nature reserves and covenanted areas permanently protect a sample of local ecosystems, including poorly conserved and threatened ecosystems, and contribute to habitat resilience at the landscape scale to support threatened fauna still in the area. Retaining and restoring native vegetation in these highly cleared landscapes also helps control salinity and contributes to agricultural sustainability.

Threatened species recovery

The management of threatened species is a fundamental requirement of biodiversity conservation and encompasses a range of aims from preventing their extinction in the wild to returning species to viability in nature. The new Priorities Action Statements (PASs) prepared under the *Threatened Species Conservation Act 1995* (TSC Act) and the FM Act identify the many actions or strategies necessary for the recovery of species, populations and ecological communities listed as threatened. This strategic approach provides a framework for tracking the implementation of actions and reporting on outcomes. The PAS is required to report at least every three years on the status of each threatened component and the effectiveness of actions undertaken.

The NSW Government is working towards a system for more effective prioritisation which refines where in the State effort should be invested for a given species, population or ecological community, based on known distribution and preferred habitat. This improved prioritisation will enable more transparent and efficient targeting of resources to priority actions in a given context.

Additional analysis to further refine the statewide and regional prioritisation process could include the identification of those species that are wholly or largely dependent on public land for their survival (such as sandstone-dependent species around Sydney) and those species whose distribution is concentrated on private land (for example box woodlands and the associated woodland birds which are in decline). As a result, the Department of Environment and Climate Change (DECC) has identified priority actions for reserves and will track their implementation and effectiveness. Other land managers and stakeholders are also able to select actions for individual species or groups of species or ecological communities, to suit their circumstances.

Recovery and threat abatement plans will continue to be prepared where they have been identified as a priority in the PAS. Recovery plans are particularly useful where actions are complex and need a rigorous species-specific scientific basis or clear administrative arrangements. They are also appropriate where a species has a high profile and recovery demands a high level of public accountability.

Conservation across the landscape

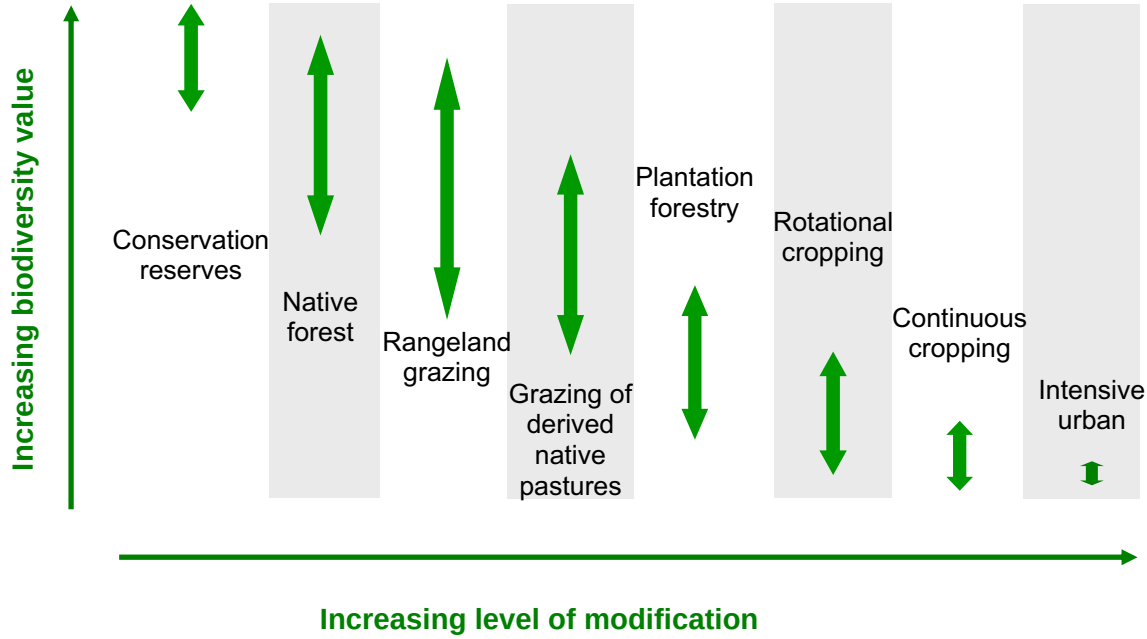
The reserve system and other protected areas are vital but unlikely ever to be sufficient on their own in area or representativeness, to protect the State's biodiversity. The amount and spatial configuration of natural areas, including reserves and the links between them, are all critical components for conservation. A recent international review of evidence-based conservation target-setting (Svancara *et al*. 2005) found that for the objectives of representativeness and persistence of biodiversity to be achieved, a minimum of 30–40% of the landscape needs to be managed for conservation, complemented by sympathetic management of a proportion of the surrounding production or urban landscape. According to Bennett (2003), conservation linkages across the landscape are needed to:

- assist movement of wide-ranging or migrating animals through developed landscapes
- facilitate dispersal of individual animals between otherwise isolated habitats or populations
- promote effective continuity and gene flow between populations in two areas by supporting a resident population within the linkage
- promote the natural continuity of habitats, communities and ecological processes between large areas such as national parks and conservation reserves
- provide an opportunity for populations to shift in response to climate change and natural catastrophes
- provide habitat and continuity for wildlife in conjunction with other environmental and social benefits.

Substantial areas of forest and woodland vegetation formations occur in State Forests in some parts of the State. They are managed to maintain biodiversity values and make a significant contribution to conservation of biodiversity in the landscape. Substantial proportions of all vegetation formations occur on privately managed land and will remain in private management. Table 1 shows the current relative extent of different native vegetation formations, as described in Keith (2004), across different land tenures in NSW. (Note the figures are only approximations.) Sympathetic management of biodiversity across all tenures, not just in the reserve system, is important if biodiversity goals are to be realised.

While land managed primarily for nature conservation will generally have a better outcome for biodiversity than land managed for other purposes, Figure 4 shows that sympathetic management of different types of land use can make a significant contribution to biodiversity conservation at the site scale. In addition, the potential exists to make significant gains at a landscape scale if such management practices are widespread. In 2006, more than 500,000 ha in NSW were the subject of improved vegetation management and/or restoration.

Figure 4 Potential range of biodiversity values for modified landscapes



Source: P Smith/DECC

Table 1 Current approximate extent of native vegetation formations across tenures

Vegetation community	Total area (km²)	NPWS (km²/%)		State Forest (km²/%)		Leasehold (km²/%)		Crown land (km²/%)		Freehold (km²/%)	
Alpine complex	1,119	1,076	96	0	0	7	1	0	0	35	3
Arid shrublands (acacia subformation)	107,518	2,885	3	0	0	96,632	90	1,109	1	1	0
Arid shrublands (chenopod subformation)	77,990	3,731	5	65	0	57,624	74	2,315	3	12,649	16
Dry sclerophyll (shrubby subformation)	77,333	22,700	29	5,780	7	1,700	2	3,111	4	41,275	53
Dry sclerophyll (shrubby/ grass subformation)	53550	8,211	15	4,388	8	1,404	3	1,187	2	38,259	71
Forested wetlands	15,571	660	4	1,149	7	481	3	180	1	8,556	55
Freshwater wetlands	7,764	145	2	9	0	5,284	68	197	3	1,784	23
Grasslands	29,395	306	1	110	0	12,470	42	329	1	16,038	55
Grassy woodlands	161,531	5,131	3	2,586	2	1,825	1	2,060	1	146,460	91
Heathlands	2,244	773	34	82	4	3	0	60	3	352	16
Rainforest	6,642	2,281	34	330	5	40	1	32	0	3,163	48
Saline wetlands	573	61	11	3	1	0	0	11	2	192	34
Semi-arid woodlands (grassy subformation)	92,043	1,659	2	252	0	28,685	31	1,735	2	57,438	62
Semi-arid woodlands (shrubby subformation)	154,301	6,038	4	1,168	1	106,450	69	2,807	2	35,955	23
Wet sclerophyll forest (grassy subformation)	24,427	4,851	20	4,202	17	239	1	219	1	13,756	56
Wet sclerophyll forest (shrubby subformation)	16,566	4,988	30	3,773	23	75	0	194	1	7,012	42

NSW has a range of mechanisms to attract landholders to biodiversity conservation. Some of the challenges for government in moving to more widespread and durable landholder commitment include:

- the need for a credible framework for priority-setting, planning and monitoring biodiversity actions at the landscape scale
- improving the cost efficiency and effectiveness of conservation actions at the landscape and site scales, engaging landholders and accounting for outcomes

- progressively moving public investment from capacity building and short-term commitments to secure, long-term conservation management arrangements over time.

We are interested in your comments on the key fundamentals for biodiversity conservation and the related objectives and key directions.

Objectives

Objective 3.1: Improve coordination of biodiversity conservation efforts

Key directions

- Develop Regional Conservation Initiatives

Objective 3.2: Improve decision-making and priority-setting

Key directions

- Develop and adopt a consistent framework for priority-setting
- Continue development and refinement of decision tools to guide and link conservation decision-making
- Improve modelling of options for conservation, including aquatic biodiversity
- Continue to invest in data improvements to support priority programs
- Develop an agreed standardised approach to mapping the type, condition and extent of vegetation communities across all tenures
- Further refine PVP developer tools to improve local and catchment-scale decision-making

Objective 3.3: Improve mechanisms to protect biodiversity at landscape scales

Key directions

- Design and pilot new administrative arrangements for:
    - management of protected areas comprising multiple small sites in fragmented landscapes
    - conservation of protected areas with multiple tenures at a landscape scale
    - coordinated regional to continental-scale conservation corridors (lifelines) with agreed cross-tenure management arrangements covering reserves and protected areas, and sympathetic management on other public and private lands
    - protection of conservation values on public lands outside the reserve system
- Build on current initiatives for integrated conservation management of native vegetation across property boundaries

Objective 3.4: Maintain an effective regulatory environment to protect biodiversity

Key directions

- Maintain the effectiveness of legislative provisions for the conservation of biodiversity
- Continue to support implementation of the native vegetation reform package by CMAs, the Natural Resources Commission and government agencies
- Encourage councils to obtain biodiversity certification for Local Environment Plans

- Evaluate planning mechanisms affecting biodiversity outcomes
- Trial and evaluate the Biodiversity Banking and Offsets Scheme

Objective 3.5: Optimise biodiversity outcomes from investment

Key directions

- Identify innovative and effective mechanisms, including a long-term investment strategy, for biodiversity conservation funding
- Foster the development of markets for environmental services
- Promote the development and adoption by industry of innovative technologies that benefit the environment
- Encourage the use of carbon emission offsets for biodiversity benefits
- Improve estimation of the costs of different strategies to conserve biodiversity, to optimise biodiversity conservation outcomes per dollar and area
- Improve the principles and priorities for public investment in incentive programs for biodiversity conservation
- Work cooperatively with the Commonwealth and other jurisdictions to:
    - effectively target funding for biodiversity and ecosystem health
    - increase the proportion of funding provided for biodiversity through national natural resource programs
    - explore additional tax incentives and duty of care requirements that will benefit biodiversity conservation

(M. Van Ewijk, DECC)

Objective 3.6: Continue to support the reserve system

Key directions

- Maintain efforts to increase the comprehensiveness, representativeness and adequacy of reserves for terrestrial, aquatic and marine biodiversity in line with the *NSW National Parks Establishment Plan*, focusing on additions which offer cost-effective contributions to slowing the rate of biodiversity loss
- Continue to improve the reserve management framework, including policy, planning, management guidance, and monitoring and evaluation
- Strategically implement the Priorities Action Statements on reserves and marine parks
- Improve the condition of important habitats and ecosystems in the terrestrial and marine reserve system and continue to report through *NSW State of the Parks*
- Develop partnerships between DECC and managers of wildlife sanctuaries and private reserves to improve the conservation status of declining and threatened wildlife
- Develop partnerships between DECC and neighbours of formal reserves to improve habitat values, support viable wildlife populations and increase the ecological resilience of reserves and surrounding landscapes

Objective 3.7: Expand protected areas to complement the reserve system

Key directions

- Cooperatively identify priority areas and targets for the establishment of protected areas outside the reserve system and coordinated conservation management of ecological corridors
- Develop criteria to guide investment in protected area planning
- Establish a comprehensive protected area reporting program in consultation with CMAs, local government agencies and non-government organisations
- Secure and conserve high conservation values on public land
- Seek to formally protect a minimum viable and representative sample of 5% of the pre-1750 distribution of those vegetation communities which have been more than 70% cleared where possible

Objective 3.8: Recover threatened species and mitigate key threatening processes

Key directions

- In implementing the Priorities Action Statements:
    - improve the prioritisation process for the selection of recovery actions and packages of actions in the Priorities Action Statements
    - continue to prepare and implement Recovery and Threat Abatement Plans where these are identified as priorities in the Priorities Action Statements
    - increase the capacity to undertake systematic, comprehensive and prioritised surveys to support recovery efforts and monitoring
    - develop and implement targeted programs to monitor the conservation status of threatened species, populations and ecological communities and evaluate the effectiveness of actions
    - identify priority species for *ex situ* conservation
- Continue to identify and list threatened terrestrial, aquatic and marine species, populations and ecological communities where applicable

Objective 3.9: Improve biodiversity outcomes across the landscape

Key directions

- Work with industry to develop and refine ecosystem and industry-based guidance on management practices to encourage improved conservation outcomes on production lands
- Expand conservation partnership arrangements with private and public providers of conservation protection and management services

4. Knowledge and information

(K. Stepnell, DECC)

Biodiversity provides many of the critical processes that make life possible and, although we gain enormous benefits from these processes, they are often undervalued. A greater understanding of the social, cultural and economic values of biodiversity is required within the wider community to maintain biodiversity and halt its decline from anthropogenic causes.

Crucial to this is an ability to build our knowledge about biodiversity and acquire adequate data and information for informed decision-making and management. Our knowledge of the variety and breadth of organisms that make up biodiversity, their particular roles in the ecosystems they inhabit and the mechanisms that drive dynamic interactions between them is often fragmented, and in some cases, rudimentary. We have even less systematic information about the potential for organisms to adapt to modified ecosystems and changing climatic regimes and how this might best be supported. Identifying and prioritising these crucial knowledge gaps and devising programs to address them are of paramount importance.

Research

Proposals for a biological diversity research program are a statutory requirement for the Biodiversity Strategy.

Cost-effective acquisition of knowledge requires a strategic and systematic program of survey and research involving collaboration across government agencies, universities and non-government bodies. Much progress has been made in ensuring that this collaboration is productive. All natural resource and environment agencies now have plans that direct their investment in science and research. These articulate the research priorities of government relating to natural resources, including biodiversity conservation. Making these priorities more widely known will enable researchers in universities and research institutions to align their own research, where possible.

Improved integration allows knowledge to be better applied. The wide dissemination and communication of biodiversity research results in the form of electronic databases and information systems, educational material and institutional linkages, is an essential part of an integrated approach to research and monitoring. These include enhancement of the Biodiversity Research Network which was established to facilitate communication and cooperation among research stakeholders, as well as continued provision of scientifically based educational material, and an expanded engagement with the Aboriginal community.

Monitoring and evaluation

Under the NSW State Plan, targets have been set for the future status of biodiversity. These targets address the extent and condition of native vegetation, sustainability of native fauna, recovery of threatened species and the impacts of invasive species. The NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy aims to measure progress towards these targets by reviewing existing data and developing new monitoring programs to measure long-term trends in biodiversity. It also aims to assess how various management actions contribute to the recovery of biodiversity. The dissemination and communication of results will be an essential part of ongoing management of biodiversity.

We are interested in your comments and suggestions on priority knowledge and information issues for biodiversity conservation.

Objectives

Objective 4.1: Establish a comprehensive biodiversity research program

Key directions

- Establish a strategic research program to support the Biodiversity Strategy and build on existing work to address key knowledge gaps in:
    - impacts, spatial operation and interaction of the key threatening processes of habitat destruction and degradation; alteration of fire and flooding regimes; introduction of invasive species; harvesting of wildlife; salinity; and climate change
    - the conservation and management needs of declining and threatened species and ecological communities to inform recovery programs under the Priorities Action Statements
    - the identification and description of poorly known organisms, such as microorganisms, invertebrates, non-vascular plants, as well as rare and threatened species
    - systematic and biogeographic studies of key taxonomic groups linked to the natural resource management standards and targets and the related MER Strategy
    - the statewide native vegetation mapping program
    - survey and research of biodiversity in poorly documented regions and marine, estuarine, freshwater and soil environments
    - understanding of disturbance regimes (such as fire and floods) and ecosystem processes (such as pollination, predation and filtration) across a range of scales from micro-habitats to bioregions, taking account of climate change scenarios
    - adaptation ecology to ensure future structural diversity, resilience and habitat function
    - conservation benefits and impacts of different natural resource-use management regimes, including set-aside areas such as no-take zones in marine parks
    - links between biodiversity and native vegetation condition

Objective 4.2: Develop a comprehensive biodiversity monitoring, evaluation and reporting program

Key directions

- Measure long-term trends in biodiversity to assess progress towards targets in the NSW State Plan (in accordance with the MER Strategy)
- Develop robust indicators for biodiversity at a range of scales
- Target species which are known or thought to be sensitive to particular key threatening processes as well as species thought to be resilient to such processes
- Expand monitoring to measure the effectiveness of specific management actions and incorporate into long-term large-scale trend monitoring where possible
- Refine predictive modelling techniques to indicate threshold conditions below which the viability of species, populations, ecological communities and ecosystem processes risk continuing decline and require intervention for maintenance or restoration
- Develop planning techniques for identifying management options to retain and restore biodiversity across the landscape

- Develop and maintain standardised flora and fauna survey guidelines and databases for storing and analysing biodiversity data, incorporating information from Aboriginal and other community groups where appropriate
- Develop scientifically based educational material tailored to target audiences to increase their awareness of the value of biodiversity, ecosystem services, the effects of human activities and the full economic, environmental and social value of biodiversity
- Support education and training for Aboriginal people to participate in biodiversity research, and educate other researchers about Aboriginal traditions, knowledge and intellectual property rights

5. Aboriginal people and biodiversity

In the Aboriginal world view, people and Country (both traditional lands and seas) are an integrated whole and the entire landscape has spiritual significance. This means that there is no separation of nature and culture, and the health of the natural environment and Aboriginal people are intimately connected. Empowering Aboriginals to care for their Country through access and management, and seeking input and advice from the community's knowledge-holders will help meet biodiversity conservation objectives and maintain Aboriginal people's cultural heritage, connection to Country and wellbeing.

Aboriginal knowledge, values and involvement with biodiversity

Aboriginal law/lore gives very clear guidance on the sustainable use of the land and its resources. For example, particular plant and animal species can be highly significant in Aboriginal cultures, placing responsibilities on the people to maintain and improve their habitats and environment through songs, dance, ritual, action and environmental management. As biodiversity is an important and integral part of their culture, Aboriginal people have a cultural responsibility to protect our State's biodiversity. These cultural associations and responsibilities for biodiversity should be respected, as should Aboriginal knowledge about it.

Aboriginal people can also help directly to maintain existing levels of biodiversity and provide key information for its restoration. Obtaining and incorporating cultural knowledge into conservation planning and involving Aboriginal people in conservation processes thus have the potential to provide both biodiversity conservation and cultural outcomes.

Access and management

Internationally, there has been a growing movement to acknowledge the rights and interests of indigenous peoples to be involved in environmental management and caring for the land, as well as providing access to land and its resources for cultural purposes. Being able to practise culture and care for the land not only maintains a culture, but improves physical health and opportunities for economic development. The NSW Government recognises the need to actively involve Aboriginal communities in a wide range of areas to contribute positively to their wellbeing.

NSW is currently addressing the rights of Aboriginal people to access land and be involved in the management of Country through co-management of parks, forests and reserves using legislative mechanisms and Indigenous Land Use Agreements (ILUAs). Reservation of land and waters is a key process for the future conservation of biodiversity and co-management programs will be essential to ensure that cultural concerns are also addressed. However, there is a need to continue to explore ways for Aboriginal people to be more involved in biodiversity management on public and private lands. New opportunities for Aboriginal communities will present themselves through tools such as BioBanking.

In another initiative, the Aboriginal Land Management Framework is being developed to better coordinate the State's approach to Aboriginal access to public lands, co-management and capacity building. The framework will recognise the concept of Country in land and sea management, coordinate government activity in the area of Aboriginal land management, and hence better allow Aboriginal groups to fulfil their responsibilities towards Country, including biodiversity conservation and management.

Case study: Indigenous involvement in Ramsar – Paroo River

The Convention on Wetlands of International Importance ('Ramsar') recognises indigenous uses and values of wetlands and water in both a material and spiritual sense. Ramsar acknowledges that the activities of indigenous peoples have contributed to the conservation of wetlands through wise use for millennia and encourages contracting parties to involve indigenous people in wetland management.

The NSW Government and the elders of the Baakandji and Budjiti people of the Paroo River have succeeded in having the Paroo River Wetlands listed as a Ramsar site. The Paroo River Wetlands comprise the Nocoleche Nature Reserve and part of the Paroo–Darling National Park, and total approximately 140,000 ha. Information from interviews with these communities on their values for the Paroo River wetlands will be published by DECC in a report, community booklet and video.

Aboriginal-owned lands

To date, much of the involvement of Aboriginal people in biodiversity management in NSW outside public lands has been through community grant programs (often in conjunction with Community Development Employment Programs) or Aboriginal Landcare groups.

Biodiversity management is also occurring on Aboriginal-owned lands however. For example, NSW has two Indigenous Protected Areas (IPAs): areas of land which the traditional Aboriginal owners have declared they will manage for the conservation of biodiversity and cultural values. The Commonwealth Government provides funding and support for the declaration of IPAs and to develop and implement management plans for the land (DEH 2006).

Beyond IPAs, a considerable amount of land is owned by Local Aboriginal Land Councils and the Indigenous Land Corporation across the State, some of which is currently being managed for conservation outcomes. In addition to this, a trend towards Aboriginal ownership of rural lands may be emerging. The issue of creating partnerships to adequately involve Aboriginal landholders in the management of the State's biodiversity is therefore likely to become increasingly important.

Case study: Co-management and partnerships in land management

DECC is working with Aboriginal people across the State to develop a range of co-management and partnership agreements that ensure the continuing practice of traditional and contemporary culture in the management of land. Aboriginal co-management fosters stronger relationships between DECC and Aboriginal communities and provides benefits to the parks system, Aboriginal people and the broader NSW community. Through co-managing parks, Aboriginal communities sustain spiritual and cultural activities, renew their cultural learning, protect cultural sites and cultural heritage, and are able to educate non-Aboriginal people about their culture.

In addition to lands co-managed by DECC and traditional owners, Forests NSW has a co-management agreement with the Keepa-Keepa elders over part of Heaton State Forest which ensures their input into land management practices. Similarly, the Darkinjung Land Council closely assists Forests NSW in managing McPherson State Forest, which contains Warre Warren Aboriginal Place. It is envisaged that co-management of parks, forests and reserves will be an increasingly important method of ensuring Aboriginal involvement in the conservation and management of biodiversity in NSW.

We are interested in your comments about ways to increase the involvement of Aboriginal people in biodiversity management on both public and private land.

Objectives

Objective 5.1: Work with Aboriginal landholders in the conservation of biodiversity

Key directions

- Increase the area of land bought to conserve biodiversity values through the federally funded Indigenous Protected Areas program
- Work with Local Aboriginal Land Councils and other Aboriginal landowners to help them conserve biodiversity on lands they own
- Work with the Indigenous Land Corporation to help landholders conserve biodiversity

Objective 5.2: Increase understanding of the Aboriginal cultural value of biodiversity

Key directions

- Adopt protocols and guidelines that recognise and protect Aboriginal interests in biodiversity in the management of public lands and waters
- Establish mechanisms negotiated with Aboriginal people to protect their intellectual property in biodiversity
- Increase the community's awareness of Aboriginal interests in biodiversity through education programs, cross-cultural training and local government and natural resource management planning
- Highlight the relationship between environmental health and the wellbeing and identity of Aboriginal communities
- Include Aboriginal experts on the cultural values of biodiversity in the delivery of education programs

Objective 5.3: Improve access to biodiversity for Aboriginal people

Key directions

- Increase opportunities for Aboriginal people to access biodiversity for cultural purposes, pass on cultural knowledge between and within generations, and renew cultural practices relating to biodiversity
- Collaboratively develop policy relating to Aboriginal access to and use of cultural resources
- Facilitate the development of Aboriginal commercial enterprises based on cultural knowledge of biodiversity
- Promote access to biodiversity through specific training programs for Aboriginal people, including delivery of training by expert elders

Objective 5.4: Increase Aboriginal involvement in the management of biodiversity

Key directions

- Increase Aboriginal involvement in the cooperative management of public land
- Develop the NSW Aboriginal Land Management Framework with respect to national parks, reserves and other public lands
- Increase the involvement of Aboriginal people in the biodiversity employment sector

6. Community involvement

Community support, involvement and leadership have contributed substantially to the conservation of biodiversity, such as through advocacy for the protection of important areas. As the level of community awareness continues to grow, government–community partnership arrangements are expected to increase. This is likely to include the protection of more private lands, supported by industry and philanthropic contributions with links to government programs. In addition, primary industries are increasingly aware of their reliance on ecosystem services and are developing best-practice biodiversity and natural resource management standards.

Landholder engagement

Conservation gains are being made through private and community actions across a broad range of programs. Individuals, groups and private organisations are entering into management agreements, conservation covenants and land acquisition for conservation management, as well as habitat and wildlife restoration. Landholder networks include Landcare, the Ramsar Managers Network and conservation management networks focused on managing threatened habitats and ecological communities with incentives or extension support from government.

A range of property-scale mechanisms are engaging landholders in conservation. DECC's Conservation Partners Program, for example, offers conservation agreements which run with title, as well as wildlife refuges, which allow for ongoing sustainable production and managing for conservation. Catchment Management Authorities also engage with landholders and provide incentives for rehabilitation and management of native vegetation.

In a review of native vegetation management on private land in NSW, Greening Australia identified a number of key issues affecting landholders' capacity to better manage native vegetation (Greening Australia 2003). These include:

- the need for best-practice management on private land in the context of vegetation management planning
- the need for specialist technical extension to avoid inappropriate management practices for remnant and regeneration vegetation communities
- reluctance to take on new ideas and diversify into land management that supports sustainable vegetation management

(M. Van Ewijk, DECC)

(DECC)

- gaps in technical expertise and advice, with demand for these services exceeding supply, impeding the achievement of regional targets and capacity to meet regional plans
- the need for access to information and knowledge sharing
- the need for informal, practical and locally relevant training.

Landholder take-up of voluntary mechanisms is growing, supported by government incentives. Investment to deliver public conservation benefits will be a continuing focus of government effort. The key task is to ensure that investment is focused so that:

- the best available data and expertise are used
- the highest conservation and threat abatement priorities are addressed
- conservation objectives are clearly identified
- landholder knowledge and the level of commitment is reflected in program design and the size and duration of funding
- effective monitoring is in place
- extension support is provided and is consistent across all arms of government.

Case study: Conservation Management Network for grassy box woodlands

Grassy box woodlands once dominated the western slopes of NSW from Queensland to Victoria, before being extensively cleared for grazing and cropping. Since they occur on some of eastern Australia's most fertile soils, the once continuous grassy box woodlands have been reduced to widely scattered remnants of varying size, quality and tenure. About 1% of the former woodlands remains in a natural condition, with 20–25% in a potentially recoverable condition. The rest is often severely degraded and includes the white box/yellow box/Blakely's red gum woodland, an endangered ecological community.

The conservation management network (CMN) model is based on the voluntary involvement of public and private landholders. Sites are managed within agricultural production systems. In some cases management is only for conservation values, while in others sites continue to be used for production, such as grazing, but are managed in ways that maintain or improve their conservation values.

A CMN coordinator provides support to the network, for example by distributing information on best management practices and activities across different sites. The coordinator also liaises with leading researchers and together they coordinate field days to promote active learning by members and to support an adaptive management approach. This involves landholders trialling and evaluating management techniques and providing feedback to improve outcomes from future management actions.

The CMN for grassy box woodlands now has 736 members, 400 of whom are private land managers. Most are managing for conservation within a grazing system. Over the past three years, 700 sites on these properties have been surveyed to provide the managers with baseline data for future monitoring. The goal of the network is to maintain and improve the quality of these sites by providing managers with knowledge and management information including best management practices.

There is now greater focus on agricultural production systems which encourage and enhance all aspects of native and commercial biodiversity. Practices that suit the local environment, increase landscape health and contribute to the retention of both functional and intrinsically valued native species include (Lines-Kelly 2003):

- production systems that enhance soil health and break disease cycles
- production systems that use water more efficiently
- integrated pest and disease management strategies that control invasive species and harness the work of native predators, reducing the need for pesticides
- targeted feral animal eradication and weed control to protect significant biodiversity assets
- restoration of native plant communities and expanded use of native grasses in grazing
- involvement in native vegetation management planning
- farming within the capabilities of the soil and topography.

Case study: Engaging the Australian rice industry in biodiversity management

The Australian rice industry developed a Biodiversity Strategy and Plan in 2002 which recognises that there is an important role for biodiversity conservation in highly modified farming landscapes. Three key elements were identified as being important to the success of the strategy and plan:

- participation by a large proportion of growers
- implementation of practical guidelines
- recognition of growers' achievements.

The strategy was followed by development of the Environmental Champions Program which was driven by growers and involved all relevant partner organisations. This voluntary program, delivered through cluster groups of farmers, had the involvement of 20% of farm businesses in the industry within two years of being rolled out.

The program's pathway for biodiversity conservation involves increasing knowledge, identifying biodiversity, planning, on-ground protection and enhancement, and monitoring. An example of the success of this approach is a cluster group which has worked together to improve the biodiversity of their local area near the Murrumbidgee River. Through group planning and linking with incentives and knowledge of their irrigation company's Land and Water Management Plan, 10 farmers are working to restore vegetation across their local landscape and link it to the Murrumbidgee River corridor. Over six months, 500 hectares of vegetation was planted in an area within the Murrumbidgee irrigation project. The group is also involved in a vertebrate study which will look at the impact of these actions on local vertebrate diversity.

Community understanding and awareness

Social research every three years by DECC, into the community's environmental attitudes, knowledge, skills and behaviour shows that NSW people rank biodiversity in the top three or four environmental issues (DEC 2006c). Climate change is also ranked in this group.

Information exchange between those with a stake in biodiversity can change the way people perceive, value and manage biodiversity. The value of community involvement ultimately rests on the level of community knowledge and understanding of the importance and value of biodiversity, the threats it faces and the actions that can mitigate those threats. Catchment Management Authorities, agencies such as DECC, DPI, the Department of Water and Energy and the Department of Education and Training, universities and education authorities are key partners in increasing understanding and awareness, to improve biodiversity outcomes.

A community education strategy is a statutory requirement of the Biodiversity Strategy. NSW now has a comprehensive Environmental Education Plan (DEC 2006d), which sets out strategies and actions for biodiversity conservation. The plan incorporates training courses for farmers and rural landholders on environmental sustainability and actions to improve their

understanding of landscape and catchment management issues such as soils, water, vegetation management and cultural heritage. Specific actions to promote biodiversity conservation include reserve-based interpretation programs, education programs to promote the conservation of marine biodiversity, fire management education, and enhancing community and industry capacity for involvement in conservation on private and public lands through conservation partnerships. As the education plan is reviewed and updated on a rolling three-year basis, priorities and actions for biodiversity education will be progressively refined.

Community partnership and leadership

The community and conservation groups play a critical role in on-ground biodiversity conservation through:

- voluntary organisations that identify, propose and advocate for the establishment of reserves
- alerting government to site-based threats, such as illegal land clearing, development activities, accidents, pollution events and shooting of wildlife
- weed control activities in conservation reserves, public land and private lands with high conservation values
- participating in governance arrangements, such as advisory bodies and regional committees
- promotion of Landcare to improve the condition and rehabilitation of private land
- assisting in species surveys, for example, of birds, fish and whales
- identifying and reporting on invasive species
- habitat restoration
- site management
- wildlife rescue
- bushfire management.

We are interested in your comments and suggestions on ways to build community awareness, involvement and partnerships to protect biodiversity.

Objectives

Objective 6.1: Increase landholder engagement

Key directions

- Identify priority areas for targeting voluntary conservation mechanisms and incentives
- Develop recommendations on best-practice conservation management for landholders in different types of landscapes
- Provide regionally tailored extension programs and information on property management planning for the retention and restoration of biodiversity on private land
- Encourage and support landholders in coordinated conservation actions, including Conservation Management Networks and other actions in the Priorities Action Statements, to recover threatened species, populations and ecological communities

Objective 6.2: Increase community understanding and awareness

Key directions

- Implement the biodiversity actions in the NSW Environmental Education Plan: *Learning for Sustainability 2007–10*, and review effectiveness to inform future education planning
- Promote implementation of the Department of Primary Industries Protected, Threatened and Pest Species Sighting Sheet Program
- Promote the value of local urban bushland and backyard biodiversity and provide guidance on specific actions that can make a difference
- Support native vegetation management committees, Landcare groups, etc. to undertake community education, including seasonal weed and pest control campaigns
- Continue to involve community groups in habitat rehabilitation, monitoring and reporting programs

Objective 6.3: Enhance community partnership and leadership

Key directions

- Encourage community partners to be advocates within their communities and support community awards and recognition
- Support conservation groups and provide opportunities for them to engage with government processes
- Continue to support and encourage community engagement in reserve management
- Work with local nurseries to encourage use of non-invasive species
- Work with aquarium enthusiasts to prevent the accidental release of aquarium species into natural waterways
- Support local councils to establish clear conservation objectives for small urban reserves, based on their values and the threats to them, and establish cooperative arrangements with neighbouring landholders

7. Climate change

Human-induced climate change is sometimes called global warming, because of the magnitude of change it is likely to cause, including its impacts on biodiversity. In June 2005, NSW became the first jurisdiction in Australia to commit to ambitious long-term emission reduction targets:

- a 60% cut in greenhouse emissions by 2050
- a return to year 2000 greenhouse emission levels in NSW by 2025 (NSW Greenhouse Office 2005).

The *NSW Greenhouse Plan 2005* establishes a long-term plan for the State to achieve these emission reduction targets. In addition, NSW has developed a *Biodiversity and Climate Change Adaptation Framework* and the *Department of Environment and Climate Change NSW Adaptation Strategy for Climate Change Impacts on Biodiversity (2007–08)*. Through these NSW has made a significant commitment to implementing the *National Biodiversity and Climate Change Action Plan 2004–07* and funding research into the impacts of climate change on biodiversity and ways to ameliorate these, under the *NSW Greenhouse Plan 2005* (NSW Greenhouse Office 2005). NSW is also committed to developing a Climate Change Action Plan, which will set priorities for adaptation to climate change.

Measures to reduce greenhouse gas emissions globally will slow the rate of climate change and may eventually limit future change if greenhouse gas concentrations can be stabilised. However, very large emission reductions are required for stabilisation to be achieved within the next century or so, as carbon dioxide and other greenhouse gases have long atmospheric lifetimes (Whetton 2003). The Intergovernmental Panel on Climate Change has argued that adaptation is a necessary strategy at all scales to complement efforts to mitigate climate change (IPCC 2001). The scientific reality is that profound impacts of climate change will be felt over the next millennium regardless of emission reductions, and identifying and ameliorating these impacts must be as high a priority as emissions control (Hughes 2003a).

(D. Peryman, NPWS)

Regardless of any future reductions in greenhouse gas emissions, some climatic changes will occur due to the level of gases (and their lifetimes) already accumulated in the atmosphere and the slow response of the climate system. Adaptation to this will involve adjusting our management of the environment to reduce vulnerability to the inescapable impacts of climate change and facilitating natural adaptive processes, such as shifts in species ranges, where feasible and desirable. Anthropogenic (human-induced) climate change has been listed as a key threatening process under the *Threatened Species Conservation Act 1995* (TSC Act).

Impacts and adaptation

Forecast climate changes include increasing temperatures; rising sea levels; changing rainfall patterns; more extreme weather events; more frequent and intense bushfires; more intense and prolonged drought periods with a reduced quantity and quality of surface water; and changes to the chemistry of ocean waters. These changes will have significant impacts on many ecosystems and native species, exacerbated by their interactions with existing threats to biodiversity, such as greater potential for the spread of invasive species, changed wildfire regimes and prolonged low or no flows in rivers. Cleared and fragmented landscapes will impede species' adaptation and range shifts for species with slow or localised dispersal mechanisms.

There is already global and Australian evidence of changes in species' ranges and life-cycle events. The most vulnerable ecosystems include coastal ecosystems, alpine areas, rainforests, fragmented terrestrial ecosystems and areas vulnerable to high fire intensity and frequency, or low supplies of fresh water.

(B. Smith, NPWS)

Climate change impacts in the Snowy Mountains

Kosciuszko National Park contains the largest continuous area of alpine and subalpine ecosystems in Australia and is a UNESCO biosphere reserve (Costin 1989; Green 2003; DEC 2006g). Climate change has been identified as one of the greatest potential threats to the ecosystem services and natural values of the park (Green 1998; ISC 2004; Pickering *et al*. 2004).

Green (2003) has noted that there is evidence that mammals and birds have already responded to the 30% decline in snow cover in the park over the last 45 years. For example, there is an increased penetration of feral mammals into alpine and subalpine areas, and a prolonged winter presence of browsing macropods. While birds are less constrained by altitude, there has been an observable change in the arrival times of migratory species in the mountains.

The worst-case scenario predictions modelled by CSIRO could see a contraction of the snow country to a small area centred on Mount Kosciuszko by the year 2050 and the possible loss of alpine ecosystems and extinction of species whose climatic ranges are already limited to the mountain-tops (DEC 2005). These include such species as the southern corroboree frog (*Pseudophryne corroboree*) and the mountain pygmy possum (*Burramys parvus*). The breeding success of mountain pygmy possums is directly related to the depth of snow cover, and if this continues to contract the survival of the species may be seriously threatened (Brereton *et al*. 1995). Changes will not only be confined to changes in snow cover and alpine habitat, but will also include increased temperature, reduced rainfall and higher UV levels (ISC 2004).

DECC has conducted several monitoring programs in the alpine region. These include monitoring:

- the break-up of ice on alpine lakes
- the duration of ephemeral ice ecosystems, snow depth and temperature beneath snow cover
- vertebrate fauna responses to a 30% reduction in snow cover over the last 45 years
- the snowpatch communities and conducting transects to sample invertebrate responses.

The Independent Scientific Committee has found that in most climate change scenarios, large protected areas such as Kosciuszko National Park will become increasingly important as biodiversity refuges (ISC 2004). Actions to combat the threat of climate change in this region are detailed in the *Kosciuszko National Park Plan of Management* (DEC 2006g).

Extract from DECC 2007

(K. Gillett, NPWS)

(L. Broome)

The direct impacts of climate change on species and ecosystems may include (Hughes 2000; McGlone 2001; Hughes 2003b):

- range shifts and species movement – movement of species towards the poles or to higher elevations by progressive establishment of new local populations
- extinctions of local populations along range boundaries at lower latitudes or elevations
- changes in productivity and nutrient cycling within ecosystems, due to the combination of climate change and increases in carbon dioxide
- increasing threats to species/systems already under stress if extreme events become more frequent and/or severe
- increasing threats to freshwater ecosystems through decreasing flows and changes in water temperature and chemistry
- increasing invasion by opportunistic, weedy and/or highly mobile species, especially into sites where local populations of existing species are declining
- progressive decoupling of species interactions, such as plants and pollinators, due to mismatched phenology.

Ecologists have recently made the first estimates of the extent to which natural ecosystems can adapt to a changing climate with regard to the conservation of biodiversity (Steffen 2006). It has been estimated that the maximum degree of climate change that can be tolerated without significant loss of biodiversity is a temperature rise of 1.5°C above pre-industrial levels, limited to below 0.5°C per century (van Vliet & Leemans 2006).

Depending on the level and speed of warming, an increasing number of species will be at risk of extinction in the wild during this century. The current extinction rate, 100–1000 times greater than the background rate as shown in the fossil record, is projected to increase by more than 10 times this already high rate (Millennium Ecosystem Assessment 2005).

There are significant uncertainties about the rate and speed of change, hence designing adaptation actions for biodiversity needs to take account of this and the risks and benefits of acting or not acting. Initially actions should focus on reducing existing threats that will compound the effects of climate change, such as land and water degradation and pollution, invasive species, habitat fragmentation across the landscape, and protecting the most vulnerable species and ecosystems where this is a practical long-term strategy. These are 'no regrets' measures, valuable for biodiversity conservation now as well as in the future. Designing more tailored actions depends on better information and understanding of likely impacts and options.

As foreshadowed in the *Greenhouse Plan 2005*, NSW has released its *Biodiversity and Climate Change Adaptation Framework* and the *Department of Environment and Climate Change NSW Adaptation Strategy for Climate Change Impacts on Biodiversity (2007–08)*, as the State's response to the *National Biodiversity and Climate Change Adaptation Plan*. The national plan commits all governments in Australia to preparing a three-year plan that begins to address adaptation needs. Key strategies include research; promoting ecological connectivity to aid migration and dispersal of species; protecting climatic refuges; creating specific management zones around important habitats; and making adjustments to existing programs where information suggests this will increase ecological resilience and protect vulnerable species and habitats (NRMMC 2004). In addition, the *NSW Greenhouse Plan* includes actions to support adaptation to change by biodiversity, including funding for research[3].

[3] See the NSW Greenhouse Office website at www.environment.nsw.gov.au/climateChange/understanding.htm

The uncertainties associated with climate change and its impacts are best approached through a risk management framework that aids management decisions, to avoid or mitigate undesirable effects in the absence of conclusive science. The potential risk needs to be identified, its likelihood and consequences assessed, and options for action considered in light of the relative effectiveness and costs of action or inaction in reducing or removing undesirable impacts. Table 2 shows a range of possible responses to risk.

We are interested in your comments and suggestions about effective ways to address the need for biodiversity to adapt to climate change.

Table 2 Possible actions to manage the risk of climate change impacts on biodiversity

Avoid risks

- Emissions control to reduce magnitude of total impacts
- Identify and avoid high-risk activities in adaptation planning, such as:
  - investments in hot, dry edge of range areas or isolated remnants other than refuges
  - naïve responses, e.g. ad hoc translocations/corridors/revegetation

Reduce risks

- Assist natural adaptation of mobile or widely distributed species, especially in fragmented landscapes
- Focus on retention and ecological resilience of large natural areas and expand protected areas further to increase adaptive outcomes
- Identify landscape linkages that increase adaptive potential and prioritise off-reserve investment for connectivity and ecological resilience
- Preserve climatic refuge areas and buffer against other threats
- Manipulate habitat to protect species/ecosystems *in situ* or to accommodate shifting species – prioritise techniques
- Translocate species
- Assess feasibility of simple reserve-based observation stations sampling ecosystem and site characteristics to inform adaptation planning and provide small-scale data on thresholds to change
- Expand/maintain efforts to build continental monitoring transects

Accept risks

- Focus on high-profile populations for the most at-risk species
- Focus on those isolated, small and vulnerable natural areas of high conservation value that can be buffered against climate change and other threats
- Adopt last-resort measures for species likely to become extinct in the wild: conservation *ex situ*, herbarium/museum and/or gene banking specimens/records

Source: adapted from DEC 2006e

Objectives

Objective 7.1: Identify and manage impacts of climate change on biodiversity to minimise species loss and build ecosystem resilience

Key directions

- Implement adopted climate change and biodiversity adaptation strategies and frameworks
- Progress and refine adaptation planning for biodiversity, including research, modelling, monitoring, awareness-raising and guidance for conservation programs based on best available information

- Identify the species and ecosystems most vulnerable to a 2°C rise in temperature and seek to protect in the wild where ecologically and economically feasible
- Identify and seek to protect climate refuge/sanctuary areas from other threatening processes and maintain/restore their resilience
- Maintain/restore resilience in high-conservation-value landscapes, including reserves, to reduce other threats to biodiversity and buffer against climate change
- Identify priorities for maintenance/restoration of cross-tenure habitat connectivity across altitudinal and latitudinal gradients, including links between reserves and protected areas and their surrounding landscapes, and foster protection with landholders

8. Invasive species

Invasive species are a major threat to biodiversity in NSW, with their impact likely to increase due to climate change. Preventing their introduction or early detection and eradication of new incursions are the most cost-effective ways of managing invasive species. However, many invasive species are already widely established in NSW and their complete eradication is rarely achievable. In these situations, it is necessary to prioritise pest management efforts to areas where the benefits of control will be greatest.

Background

Significant environmental vertebrate pests in NSW include foxes, feral cats, goats and pigs, rabbits, deer, wild horses, cane toads, some birds (such as common mynas) and various introduced fish species (such as carp and gambusia). Serious NSW environmental weeds include the seaweed *Caulerpa taxifolia*, bitou bush, lantana, blackberry, Scotch broom, camphor laurel, rainforest vines and many perennial grasses. NSW has more than 1350 naturalised non-native plants (Coutts-Smith & Downey 2006). The number of weeds continues to grow despite extensive efforts to stop new introductions. Approximately 70% of weed species have escaped from gardens (Groves *et al*. 2005), so many future pest species are probably already present in gardens. The problem of invasive microorganisms and invertebrates is also being recognised. Species causing concern include frog chytrid and phytophthora fungi, red fire ants and yellow crazy ants.

Figure 5 illustrates the number of species, populations and ecological communities threatened by selected terrestrial invasive species.

A number of native species are also having an impact on natural ecosystems through an expansion of their ranges or increased abundance. These include the very territorial noisy miners which exclude small birds, and the adaptable *Acacia saligna* from Western Australia that can displace local native species.

Case study: Management of bitou bush through a Threat Abatement Plan

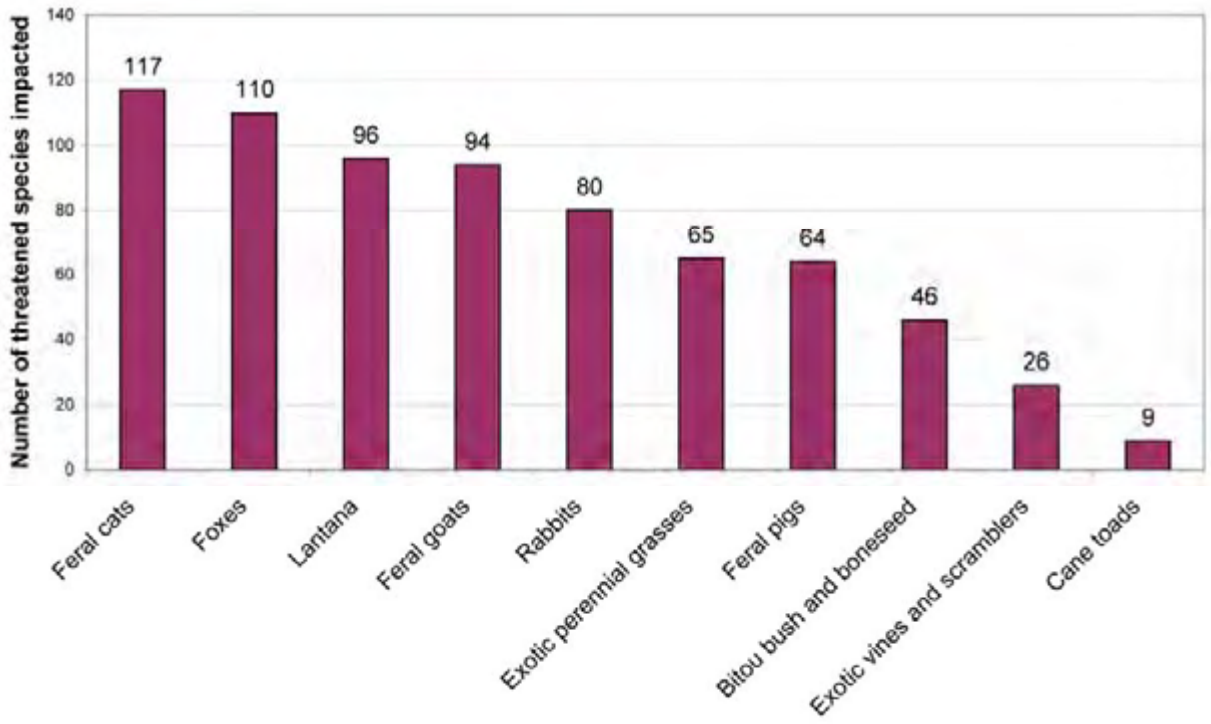
Bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata*) is a highly invasive coastal shrub of South African origin, which has invaded 900 kilometres of the NSW coastline. Bitou bush has been declared a weed of national significance, a noxious weed, and a Key Threatening Process in NSW.

The NSW Bitou Bush Threat Abatement Plan (DEC 2006e) is part of a national effort to address this threat. The plan identifies priorities for management independent of land tenure by prioritising the species at greatest risk from bitou bush and the sites where its control is most critical. The plan lists 19 species, two endangered plant populations and eight ecological communities at greatest risk from a total of 158 species, three populations and 24 ecological communities that are adversely affected by bitou bush invasion.

A bitou bush biological control program has resulted in the release of four agents. One of these, the bitou seed fly, is established along the NSW coastline and in some areas, fly populations have reduced bitou seed production by over 50%. Current research is focusing on the leaf-roller moth (*Tortrix* sp.). Poor moth establishment has been linked to high predation of the larvae (98% mortality) and drought conditions. However, Botany Bay National Park now has an established and expanding population of moths and if this can be replicated at other locations, it is likely to have a significant impact on bitou bush infestations.

Bitou bush control programs must continue for several years to reduce seed reserves in the soil. Volunteer groups such as Dunecare groups, are important in maintaining long-term control.

Figure 5 Numbers of species, populations and ecological communities[(a)] threatened by selected terrestrial invasive species[(b)]



Notes. [(a)] Threatened species, populations and ecological communities listed under the TSC Act.
[(b)] The invasive species selected are generally those listed as key threatening processes (except lantana).
Source: Modified from Coutts-Smith & Downey 2006.

Current management

The Priorities Action Statements provide Catchment Management Authorities and land managers with a prioritised list of key actions to protect threatened biodiversity and will facilitate the efficient use of resources in managing invasive species. The NSW Government is also developing an invasive species plan that will link with the NSW Biodiversity Strategy, the Priorities Action Statements, individual invasive species plans and catchment action plans.

Managing a large number of established invasive species already having adverse impacts on biodiversity requires anticipating the interactions between different invasive species, effective control techniques, and the availability of adequate resources. Prevention of new incursions through effective border control and surveillance, risk-based decision-making and a well-resourced rapid response capability to tackle new occurrences are also important strategies. However, the number of invasive species vastly exceeds available capacity for active management.

It is predicted that under likely climate change scenarios, the impact of invasive species will become more severe in parts of the landscape, due to greater disturbance from altered fire regimes, more extreme weather events, changes to rainfall and higher temperatures. Special emphasis is needed on control and monitoring after fires, droughts, floods and other similar disturbances that facilitate the spread of invasive species.

Long-term investment in the development of biological controls needs to continue, with joint State and Commonwealth funding contributions. Several invasive species often co-exist in the same environment and have substantial interactions. These cases may need a whole-of-ecosystem approach to ensure resources are used efficiently and to avoid the replacement

of one locally eradicated invasive species by another. It is also essential to monitor the effectiveness of the controls on both the target species and at-risk biodiversity.

We are interested in your comments and suggestions for managing invasive species that threaten biodiversity.

Objectives

Objective 8.1: Limit establishment of new invasive species

Key directions

- NSW agencies work together with Australian quarantine authorities, such as the Australian Quarantine and Inspection Service (AQIS) and Biosecurity Australia, to prevent new incursions, including marine pests
- Ensure regulatory and educational arrangements are in place to significantly reduce the risk of new incursions
- Maintain a rapid response capability to eradicate new incursions, such as yellow crazy ants, red fire ants and parthenium weed
- Improve detection, collation and reporting of new incursions
- Develop and implement a risk assessment process for new (and potential) exotic invasive species
- Minimise escapes of domesticated or other exotic species (such as deer, aquarium species and invasive garden plants) or potentially invasive native species outside their natural range through cooperative measures with industries
- Develop biosecurity plans for rapid response to invasive pests in marine protected areas

Objective 8.2: Improve management of emerging and widespread established invasive species

Key directions

- Implement actions and strategies identified in the Priorities Action Statements, including the development of threat abatement plans or other on-ground control programs for widespread invasive species, such as foxes, bitou bush, lantana, carp, Lippia and *Caulerpa taxifolia*
- Manage herbivores in rangelands, such as feral goats and rabbits, to achieve regeneration of native plants and ecosystems and include conservation incentive agreements as part of management requirements
- Control environmental weeds, for example through weed management plans for Catchment Management Authorities, to protect regional priority sites for biodiversity, including terrestrial and marine reserves
- Develop and implement strategies to manage emerging invasive species, such as cane toads, red-eared slider turtles and phytophthora fungus, including a capacity to monitor their distribution and abundance
- Include guidance on managing multiple threats operating concurrently or sequentially in invasive species management plans and strategies
- Incorporate measures of impacts and the effectiveness of control measures in invasive species management programs, where possible

Objective 8.3: Establish refuges for native species most threatened by invasive species

Key directions

- Manage offshore islands to provide sanctuaries for wildlife
- Establish mainland sanctuaries for priority species and ecosystems where these can be secured and major threats controlled on an ongoing basis

Objective 8.4: Improve knowledge and tools for responding to invasive species

Key directions

- Work with research institutions to develop more cost-effective, target-specific and acceptable control methods, such as feral cat toxin, weed biocontrols and effective trapping strategies for common (Indian) mynas
- Incorporate agreed knowledge and tools into best-practice guidelines
- Improve understanding of invasive species with a focus on multi-species strategies, habitat modification and climate change as factors which may modify the impacts
- Clarify accountabilities, levels of resourcing and cost-sharing arrangements between different levels of government and agencies for the management of the impacts of invasive species on the environment
- Improve understanding of the social and economic implications of invasive species management, for example species with cultural value (such as horses); food value (such as rabbits); economic value (such as goats); or for hunting (such as feral deer and pigs) and develop acceptable control measures that do not jeopardise biodiversity

Objective 8.5: Increase community support and involvement in management programs for invasive species

Key directions

- Involve community groups in monitoring programs to detect new incursions
- Build partnerships and investigate incentives and other assistance measures to enhance the involvement of community groups in managing invasive species, particularly owners of priority control sites and reserve neighbours
- Raise community awareness of the impacts of invasive species and management options

9. Terrestrial biodiversity

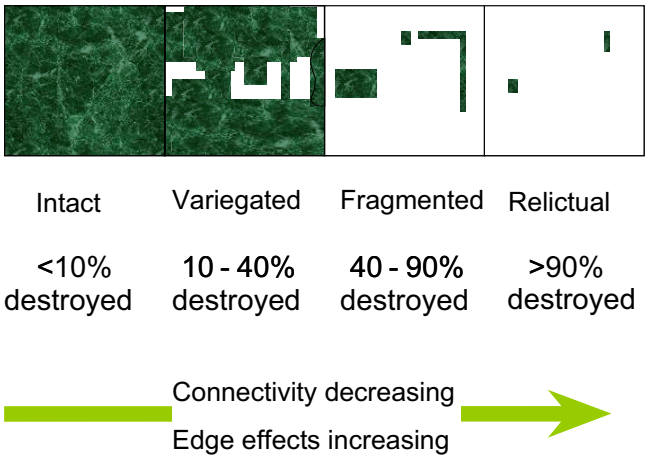
Many possible actions and important issues for terrestrial biodiversity are covered in other chapters including the reserve system, protected areas, threatened species, clearing, urban planning, landscape conservation, invasive species and climate change. The focus of this chapter is on addressing threats to terrestrial biodiversity through regional profiles, including both the legacy of past land uses and current major threats. The Regional Conservation Initiatives (RCIs) discussed in Chapter 3 could be based on the boundaries used for the regional (or zone) profiles in this chapter. RCIs would be the vehicles for identifying the most effective ways to address and prioritise major threats and opportunities for biodiversity conservation across broadly similar regions of the State.

More than a quarter of the terrestrial vertebrate animals in NSW are listed as threatened under the *Threatened Species Conservation Act 1995.* About 12% of terrestrial vascular plants are also listed. The number of animal species reliant on those plant species is unquantified but thought to be significant. In the last three years, the listing of threatened species, populations and ecological communities has grown considerably with 45 species added to the endangered list and six to the vulnerable list (DEC 2006b).

Assessing biodiversity in a landscape framework

The status of biodiversity is strongly influenced by past and current land uses. Landscapes can be placed along a connectivity continuum, as illustrated in Figure 6. The extent, intensity and distribution of different land uses and the corresponding retention, condition and spatial configuration of natural and modified habitats together determine the amount of effective habitat for different species in a landscape and its overall species abundance and diversity.

Figure 6 Landscape patterns of habitat destruction



Human impacts on native vegetation are quite marked in Australia, where broadscale clearing has been followed by agricultural or urban settlements. The extent of vegetation (or habitat) destruction varies across the country and can often be linked with land-use types.

Different regions have different levels of landscape alteration.

Arid rangelands are often intact, while variegated landscapes are generally associated with limited cropping and native pasture use. Fragmented and relictual landscapes are found when the impacts of cropping and urbanisation are highest. These landscapes have only small areas of original habitat. The less habitat remaining, the more important it is to consider landscape connections (such as corridors) between patches.

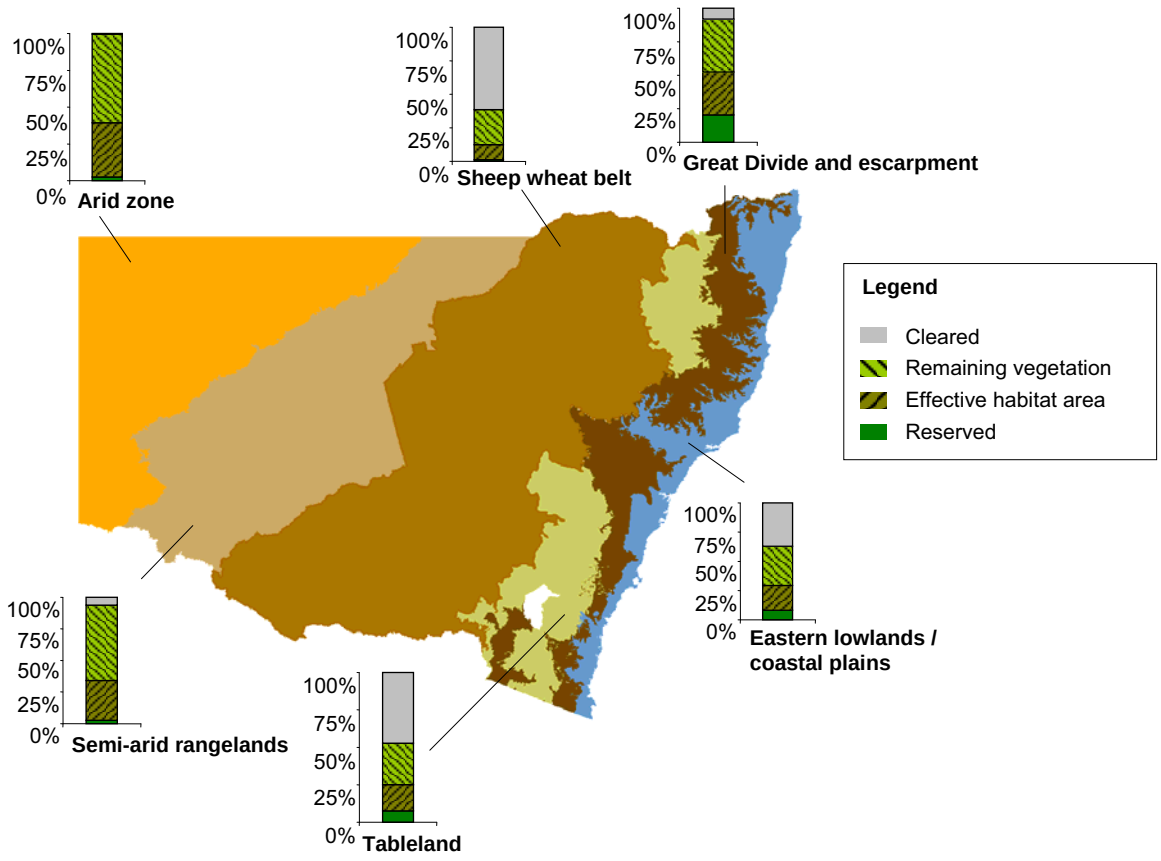
Adapted from McIntyre & Hobbs1999

The strategies used to conserve species and control threats to biodiversity differ between landscape types. For example, in those areas where extensive changes have taken place it is not feasible or socially desirable to recreate the landscape that existed prior to European settlement (Oliver *et al*. 2002), whereas in variegated landscapes, significant, cost-effective gains can be achieved from restoration.

NSW has been categorised into seven major zones for this chapter, based on land-use history and threats to biodiversity at a very coarse scale (see Figure 7). This categorisation, combined with the continuum of landscape modification, helps us to understand the current status of biodiversity in different parts of the State and the need for different strategies. Each of these zones is briefly described below. It is proposed that RCIs will describe in more detail the relevant terrestrial biodiversity characteristics, existing management and programs and the priority conservation responses to be undertaken.

Figure 7 shows the size and location of each zone, the percentage of remaining native vegetation, its effectiveness as habitat[4] for many native species, and the percentage of effective habitat currently included within reserves. Coastal urban areas and rural growth centres are not shown in Figure 7 because many of them are too small at this scale and therefore no statistics are presented for this zone. Where the zone boundaries accord well enough with bioregional or subregional boundaries, the latter have been used. The relationships between the zones and Catchment Management Authority boundaries, and bioregions, can be found in Figures 8 and 9 respectively.

Figure 7 Proposed RCI terrestrial biodiversity zones and status of vegetation coverage

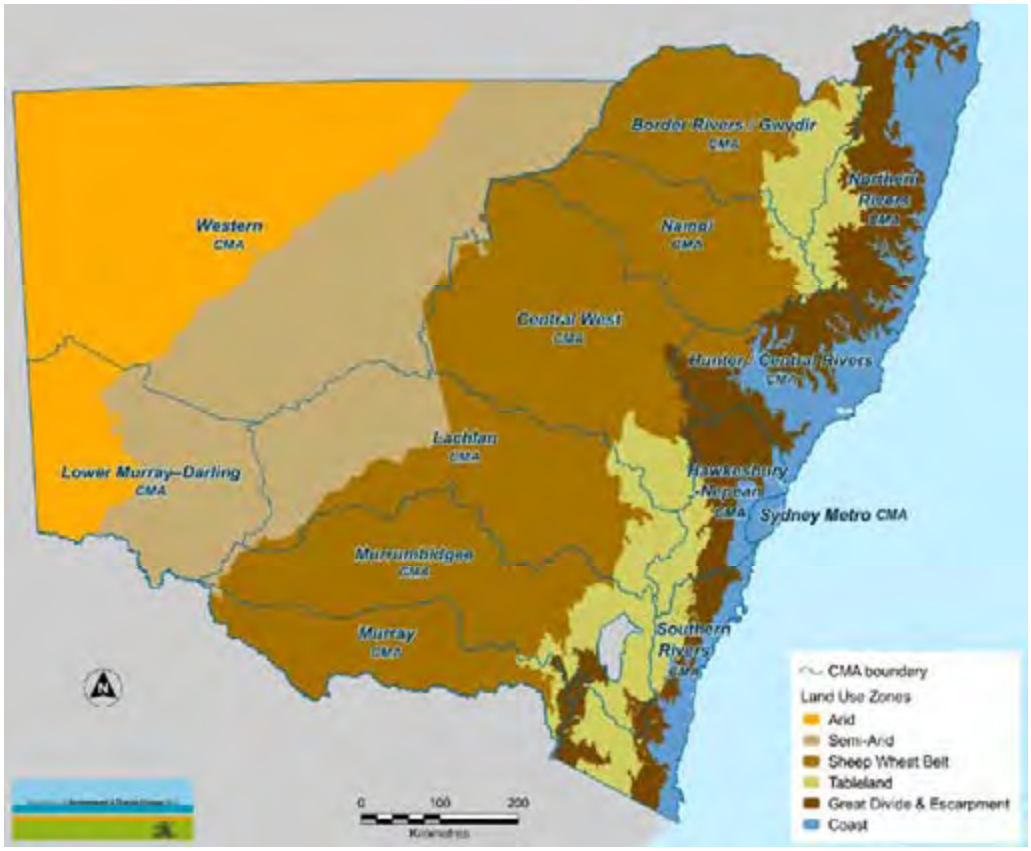


Note: Vegetation profiles have been developed using the DECC Forecaster tool.

Source: DECC GIS layer, 2008

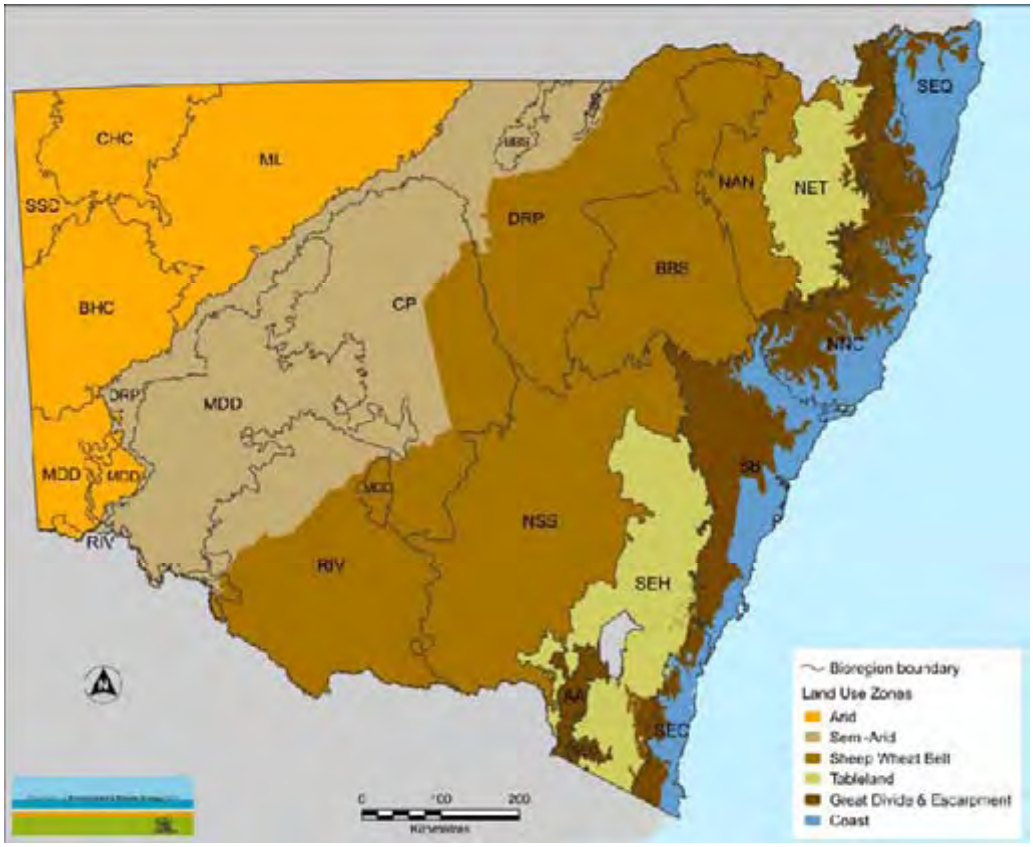
[4] 'Effective habitat area' is a modelled estimate of how much usable habitat exists for a diverse group of species. It is less than the total remaining area of vegetation because a proportion of that will not be usable habitat for many species due to small size, isolation and poor condition.

Figure 8 Land-use zones and Catchment Management Authority boundaries



Source: DECC GIS layer 2008

Figure 9 Land-use zones and bioregions



Source: DECC GIS layer 2008

1. Arid Rangelands Zone

Although this zone is 99% vegetated, its effective habitat is estimated at only 60% because of the historical impact of grazing on vegetation structure and composition, supported by artificial watering points. Historical removal of trees for fencing, mining and infrastructure has also affected the composition, structure and function of habitats.

Vegetation cover: Intact

Effective habitat: Mainly fragmented

Most significant current threats: Total grazing pressure by stock and feral and native animals; vertebrate predation by foxes and cats

2. Semi-Arid Rangelands Zone

This zone is subject to the same grazing pressures as the Arid Rangelands Zone. Grazing, combined with the historical suppression of fire and removal of trees, have transformed open woodland into low-diversity, inedible woody shrublands in some ecosystems. In areas suitable for cropping on the eastern margin and riverine plains of the zone, the extent of some vegetation communities, formerly more widely distributed into the cleared Sheep–Wheat Belt, is being progressively reduced, with implications for species connectivity between Victoria and Queensland. Groundcover vegetation is more often depleted than in the Arid Rangelands Zone due to higher stocking pressures.

Vegetation cover: Intact

Effective habitat: Mainly fragmented

Most significant current threats: Total grazing pressure; vertebrate predation by foxes and cats; fire suppression; clearing and loss of connectivity in eastern and southern margins; woody shrub regeneration

(J. Little)

(P. Green, DEC)

3. Slopes and Plains of the Sheep–Wheat Belt

This is, overall, the most intensively developed agricultural region in NSW. Prospects for restoration are considerably poorer in the south due to the dominance of exotic species in the landscape. In the north, large areas of derived native grasslands remain after clearing and thinning of the original open woodland cover. Areas of high conservation value exist on narrow bands of Crown reserves along roads and stock routes as well as on isolated hilltops, ranges and infertile areas. Isolated mature paddock trees lack native understorey but any recruitment but may still be important resources for migratory birds. A large proportion of the species and ecological communities of this zone are threatened and often occur in small patches that need active management and, for priority sites, enlargement and linking to other sites. Many small remnants suffer from too infrequent or too intense fires and recruitment of new trees and other habitat layers is limited.

Vegetation cover: Fragmented

Effective habitat: Mainly fragmented

Most significant current threats: Total grazing pressure linked to declining species and habitat diversity in woodlands and grasslands; land degradation: dieback, failed recruitment, salinity, etc.; invasive species; loss of riparian vegetation due to irrigation.

4. Tablelands

The Tablelands were one of the earliest settled parts of NSW. This zone is affected by rural dieback, often associated with pasture improvements and overclearing of the grassy box-gum, ironbark and stringy bark woodlands for grazing, and subsequent changes such as a collapse in the populations of birds which controlled defoliating insects. Loss of soil seed stores and changes to soil condition are hampering widespread efforts to restore ecosystem resilience in production landscapes. Substantial areas of dry sclerophyll forests still exist on rocky infertile soils. Remaining areas of native grasslands are mostly small and fragmented with the floristically richest remnants on Crown reserves. Many native pastures have been extensively modified with improved pasture grasses, fertilisers and heavy grazing, though there has been a recent focus on reintroducing native pastures.

Vegetation cover: Fragmented

Effective habitat: Mainly fragmented

Most significant current threats: Total grazing pressure linked to declining species and habitat diversity in woodlands and grasslands; dieback and lack of recruitment; inappropriate fire regimes; clearing for plantations, horticulture, viticulture and rural residential development.

5. Great Divide and Escarpment

This is generally the highest, most rugged land in NSW with extensive natural areas in public management, including reserves. The diversity of species and vegetation types is very high: the zone contains two World Heritage areas and is recognised as being an international wilderness hotspot.

Vegetation cover: Variegated

Effective habitat: Intact to fragmented

Most significant current threats: Fire regimes; climate change and the need for habitat connectivity; invasive species; forest dieback.

(Simone Cottrell)

6. Eastern Lowlands and Coastal Plains

This zone has very high species diversity, with more than 200 species and ecological communities listed as threatened in the southern half alone. It includes high rainfall, fertile agricultural valleys that have largely been cleared for grazing and some cropping, as well as ranges, foothills and some infertile flats that retain their native vegetation. The zone is vulnerable to continuing rural residential and urban development. Plant diversity, forest birds and invertebrates have declined in the remaining forests on higher ground due to timber production, grazing and frequent burning, and invasive species are often present. The fragmented

nature of remnants in much of the rural landscape, and high land values, limit the opportunities for landscape conservation in the more fertile valleys.

Vegetation cover: Fragmented

Effective habitat: Variegated to relictual

Most significant current threats: Climate change and the need for habitat connectivity; continuing development pressure in relictual landscapes; total grazing pressure; fire regimes; invasive species.

7. Coastal Urban Areas and Rural Growth Centres

This zone is the most intensively developed and is also expanding into adjacent zones. The principal threats are habitat loss and the expanding margins adjacent to conservation lands, and ongoing decline of natural areas within urban landscapes.

Vegetation cover: Relictual

Effective habitat: Relictual

Most significant current threats: Continued habitat loss at the zone margins and adjacent to conservation areas; ongoing decline of small natural remnants; weeds; frequent fires including arson; stormwater pollution, runoff and nutrient enrichment; domestic pets.

A summary of statistics relevant to the conservation status of biodiversity within each zone is set out in Table 3.

(H. Nicholson)

(R. Woods)

We are interested in your views and suggestions for the conservation of terrestrial biodiversity.

Objectives

Objective 9.1: Encourage and support a spectrum of sustained conservation actions across the landscape to address the legacy of past land management impacts[5]

Key directions

- In all landscape types:
    - encourage the protection and maintenance of existing natural areas and habitats, especially those in good condition
    - improve the condition of priority ecosystems and remnant habitats
    - improve habitat connectivity where ecologically beneficial
    - identify targets for conservation outcomes
    - exclude/control key invasive species

[5] Adapted from Kuginis & Smith 2004.

Table 3 Background information for terrestrial zones

	Arid Rangelands		Semi-Arid Rangelands		Sheep-Wheat Belt		Tablelands		Great Divide and Escarpment		Eastern Lowlands and Coastal Plains	
Area (ha)/% of NSW	15,546,537	19.4	16,917,516	21.1	28,910,064	36.1	6,635,524	8.3	7,170,113	9	4,828,104	6
Land management characteristics	**Area (ha)**	**% of NSW**	**Area (ha)**	**% of NSW**	**Area (ha)**	**% of NSW**	**Area (ha)**	**% of NSW**	**Area (ha)**	**% of NSW**	**Area (ha)**	**% of NSW**
Vegetation												
Cleared	62,186	0.4	1,573,328	9.3	20,265,954	70.1	4,193,651	63.2	1,218,919	17.0	2,525,098	52.3
Vegetated	15,484,350	99.6	15,344,187	90.7	8,644,110	29.9	2,441,872	36.8	5,951,193	83.0	2,303,005	47.7
Effective habitat	-	60.7	-	47.9	-	12.7	-	23.3	-	67.0	-	30.1
Land vulnerability[6]												
High	994,978	6.4	4,550,811	26.9	13,876,830	48.0	517,571	7.8	129.062	1.8	922,167	19.1
Low	4,430,763	28.5	7,832,809	46.3	8,470,648	29.3	2,554,676	38.5	724,181	10.1	1,424,290	29.5
Moderate	9,452,294	60.8	3,823,350	22.6	4,885,800	16.9	2,521,499	38.0	2,215,564	30.9	1,308.416	27.1
Other[7]	668,501	4.3	710,535	4.2	1,705,693	5.9	1,041,777	15.7	4,101,304	57.2	1,173,299	24.3
Tenure												
Crown land	295,384	1.9	321,432	1.9	404,740	1.4	145,981	2.2	200,763	2.8	207,608	4.3
Leasehold land	14,551,558	93.6	15,682,537	92.7	780,571	2.7	152,617	2.3	164,912	2.3	14,484	0.3
Freehold	466,396	0.3	219,927	1.3	26,308,158	91.0	5,341,596	80.5	2,782,003	38.3	3,616,249	74.9
Reserves	652,954	4.2	659,783	3.9	780,571	2.7	676,823	10.2	3,068,808	42.8	550,403	11.4
State Forests	15,546	0.1	50,752	0.3	636,021	2.2	318,505	4.8	946,454	13.2	439,357	9.1
Key land uses												
Grazing	14,265,174	91.7	14,988,919	88.6	18,878,271	65.3	4,266,641	64.3	1,448,362	20.2	2,018,147	41.8
Reserves	652,954	4.2	659,783	3.9	780,571	2.7	676,823	10.2	3,068,808	42.8	550,403	11.4
State Forests	–	–	–	–	636,021	2.2	318,505	4.8	946,454	13.2	439,357	9.1
Cropping/irrigation	–	–	710,535	1.9	6,446,944	22.3	59,719	0.9	–	–	–	–

Source: DEC 2006f

[6] Land vulnerability provides an indication of the potential threats to biodiversity from agriculture, based on the suitability of land for agriculture derived from land systems mapping in western NSW and on land capability mapping in eastern NSW.

[7] 'Other' refers to public land which is not mapped for agricultural suitability.

- In intact landscapes (< 10% cleared):
    - maintain habitat connectivity
    - reduce threats to condition and improve habitat quality
- In variegated landscapes (10–40% cleared):
    - retain and selectively expand existing vegetation and improve condition where biodiversity is in decline
    - limit the extent of permanent intensive land-use change that affects vegetation
    - incorporate conservation management into an expanding proportion of less intensively used landscapes
    - seek to balance the total area of land managed for intensive land use and for conservation
    - manage grazing and fire on production lands and in grazed remnants to reduce impacts on biodiversity
    - expand the area and diversity of patches across the landscape managed to conserve those species that are sensitive to grazing and other land-use disturbances
- In fragmented landscapes (40–90% cleared):
    - protect and retain remaining vegetation, especially where in good condition and in riparian corridors
    - improve the condition of habitats and selectively re-establish effective habitats where appropriate, for example, establish buffers around remnants and restore linkages to improve species persistence
    - in all revegetation actions, encourage re-establishment of diverse vegetation communities rather than standard plantings, taking account of fauna needs
- In relictual landscapes (> 90% cleared):
    - focus on enhancing the condition and size of larger, more viable patches where plants and animals with small ranges can persist
    - limit the loss of any native vegetation and offset any unavoidable loss of natural areas by conservation gains in more viable contexts
    - maintain and enhance riparian habitats as they will often be the primary habitat corridors

Objective 9.2: Control major current threats to terrestrial biodiversity

Key directions

- Encourage the adoption of grazing strategies to recover plant and habitat diversity across more of the landscape, in rangelands, woodlands and grasslands
- Manage weeds and feral animals
- Control inappropriate fire regimes and adopt ecological fire regimes based on the best available research
- Apply available techniques and technologies to re-establish a more complex mosaic of structural vegetation types in areas affected by dense landscape-scale woody shrub regeneration
- Concentrate management efforts, including revegetation, on controlling dieback and failed recruitment, salinity, erosion and other symptoms of land degradation to stabilise ecological function in areas where this would significantly benefit biodiversity
- Manage land-based sources of pollution, such as from areas of intensive land uses, to prevent the export of excessive nutrients and pollutants into waterways, including sensitive estuarine and marine environments

10. Freshwater aquatic biodiversity

Freshwater aquatic biodiversity encompasses the diversity of species and ecosystems in rivers, streams, lakes, billabongs, wetlands, floodplains, inland saline lakes and groundwater-dependent ecosystems. As well as their intrinsic value, stream networks and their associated riparian habitats provide vital connectivity between areas of high quality terrestrial habitat and may often be the only such linkages in an otherwise fragmented landscape. Because aquatic ecosystems interact in complex ways with their surrounding catchment and downstream estuarine and marine ecosystems, those related ecosystems are included when relevant.

Possible objectives and key directions for reservation, invasive species, climate change and threatened species are found in other chapters.

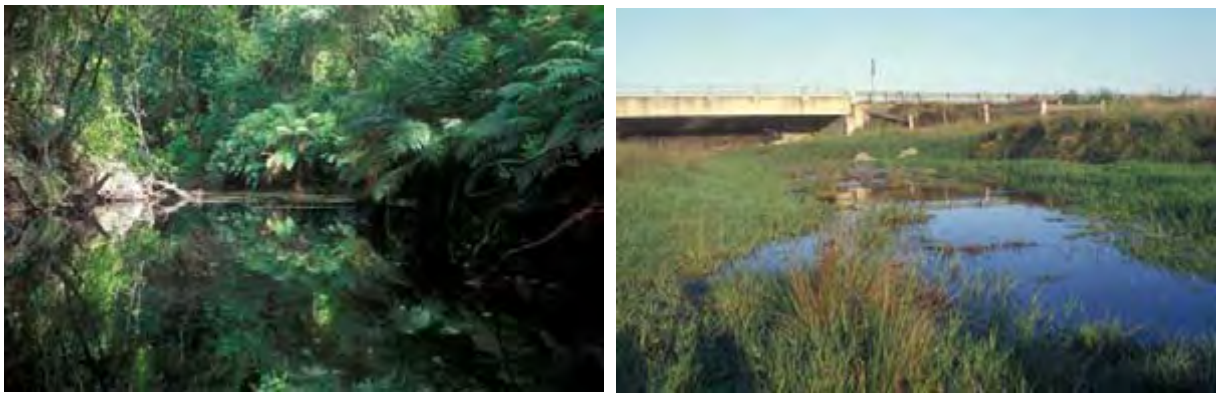
Threats to aquatic biodiversity

Aquatic ecosystems have been greatly modified by many activities since European settlement, including river regulation, agricultural practices, over-fishing, urban and industrial development, and the introduction of non-native species. The impacts from these activities, both past and present, are ongoing, and in many cases the full impacts of past decisions are still to be felt. Many native aquatic species have experienced declines in their numbers and distribution, and without appropriate action, these trends can be expected to continue.

Fifty per cent of the length of the NSW rivers assessed by the *National Land and Water Resources Audit* had impaired aquatic biota, and 97% were either significantly or substantially modified (NLWRA 2002). Out of 643 survey sites throughout NSW, only 96 (15%) were identified as good or excellent in terms of the 'naturalness' of the fish community at those sites, while 114 sites (18%) were classed as poor or very poor. Between 40% and 50% of important wetland ecosystems, such as the Macquarie Marshes and along the Murray River, are degraded or significantly reduced in extent.

Estimates of the loss of coastal wetlands since European settlement range between 60% and 70% (Bowen *et al*. 1995). All the floodplain wetlands of coastal NSW are listed as endangered ecological communities under the *Threatened Species Conservation Act 1995* (TSC Act). An assessment in 2005 of 164 north coast wetland vegetation communities found that only 19, mainly heathland communities associated with dunal environments, were adequately represented in the reserve system (Griffith 2005).

Loss of species diversity weakens natural ecosystems and diminishes ecosystem services and this can have social and economic impacts. Results in 2005 of an annual aerial survey of waterbird numbers in eastern Australia showed they were at their fifth-lowest level in 23 years; six species were at the lowest numbers ever recorded. The birds were strongly clustered around the small number of wetlands that still held water during the prolonged drought conditions (Kingsford *et al*. 1999; Kingsford *et al*. 2004; Kingsford *et al*. 2005).



(both E. Turak, DECC)

A range of aquatic species is listed as threatened under the TSC Act and the *Fisheries Management Act 1994* (FM Act), including around 16% of the State's freshwater fish species and 30% of amphibian species.

The FM Act also lists five key threatening processes, including degradation of native riparian vegetation along NSW watercourses; removal of large woody debris from streams; and instream structures and other mechanisms that alter natural flow regimes in rivers and streams. Many of the western-flowing rivers in NSW are listed as endangered ecological communities under the FM Act.

Alteration of natural flow patterns

Alteration of natural flows, and the installation of structures and mechanisms limiting natural flow regimes, are listed as key threatening processes under the TSC and FM Acts, respectively. Water extraction and regulation of rivers with dams and weirs have significantly altered natural flow patterns and reduced the amount of water available to the downstream environment. These activities together with unsustainable extraction from the Great Artesian Basin, have had severe impacts on many inland aquatic ecosystems, including groundwater-dependent ecosystems. Some systems are so stressed by reductions in volume and changes in flow patterns that addressing other impacts will be highly constrained without more water.

The development of the Murray–Darling Basin's water resources, and in particular the reduced flows associated with these developments, has also had a major impact on the riverine ecosystem (Whittington *et al*. 2000). Impacts related to the lower flows include:

- reduced areas of wetlands
- degradation of floodplain forests and groundwater-dependent ecosystems
- reduced and less diverse populations of native plants and animals
- a worsening of the problems of salinity, pest species, eutrophication and blue-green algal blooms
- alteration of the shape of the basin's rivers.

In contrast with the impacts of water extraction, some ecosystems in the Murray–Darling Basin are affected by increased inundation that has also altered habitats and adversely affected aquatic ecosystems. Often in these systems, improving the condition of rivers and wetlands will require less water to be extracted, which will increase the volume of environmental water available overall as well as bring greater variability to flow regimes. This will also help to ensure that environmental water is managed to maximise ecological benefits.

Water for the Future, which was announced by the Australian Government in April 2008, provides a long-term focus on securing water for all Australians and is designed to ensure water use is placed on a sustainable footing within the next decade. The plan will significantly improve water management across the nation with a special focus on the Murray–Darling Basin. It will accelerate implementation of the National Water Initiative and build on work begun under the Living Murray Initiative and the Australian Government Water Fund. The NSW Government has joined with other States and Territories in signing an intergovernmental agreement on Murray–Darling Basin (MDB) Reform that establishes the new governance of the MDB.

Fishing

Although commercial fishing for native species in inland waters no longer occurs, the effects of past depletion of stocks may still be influencing aquatic biodiversity. Today, the major direct fishing pressure on a number of freshwater species is recreational fishing, although a rigorous estimate of the level of impact is problematic. Alterations in the distribution and

abundance of any species can affect ecosystems and habitats through alterations in food webs and species interactions. Recreational fishing is managed by a combination of possession and size limits, temporal and spatial closures and gear restrictions. Most target species are re-stocked.

Land management activities

Activities, such as land clearing, grazing and the application of fertiliser and pesticides, have adverse impacts on aquatic ecosystems even when they occur far from water. In the Murray–Darling Basin, floodplain water harvesting increases the pressures on biodiversity in regulated river systems. The export of nutrients from catchments across the State can lead to eutrophication (oxygen depletion) in water bodies.

On the coast, urban development, flood mitigation, agriculture and acid sulfate soils are significant threats to wetlands. In particular, diffuse sources of pollution remain significant pressures on coastal rivers and estuaries.

Minimising adverse impacts from land use and activities throughout a catchment is a vital part of rehabilitating degraded aquatic ecosystems and protecting healthy systems.

Habitat loss and degradation

Within river channels, important causes of habitat loss and degradation include in-stream structures such as dams and weirs, cold-water releases from major dams, sedimentation, development works, removal of large woody debris (snags) from streams, and salinity. The removal of riparian vegetation, damage to stream banks by stock and alteration to the structure of stream beds have all contributed to a change in the morphology of river channels.

Coastal floodplain drainage and the disturbance of acid sulfate soils have caused the loss and degradation of aquatic ecosystems. Localised efforts to address the problem have had limited success, but with public support, large-scale land-use change to restore natural flow regimes could restore these ecosystems, albeit slowly. On riverbanks and floodplains, riparian vegetation has been cleared and floodplains have been disconnected from their rivers by levees and other flood control devices. Riparian revegetation programs, removing non-critical flood control devices, construction of fishways and improved floodplain management, could minimise or reverse these impacts.

Impacts from climate change and invasive species are also important threats to freshwater aquatic biodiversity and are discussed in Chapters 7 and 8.

We are interested in your comments and suggestions for the conservation of aquatic biodiversity.

Objectives

Objective 10.1: Effectively manage water resources and aquatic ecosystems to conserve biodiversity

Key directions

- Secure a greater share of available water for the environment
- Measure and account for all water extractions, including floodplain harvesting
- Reduce the impact of water pollution, including cold-water pollution, on aquatic biodiversity
- Progress priorities for reservation where sufficient environmental water and other key habitat resources are potentially available to maintain their values

- Encourage landholders to protect important aquatic ecosystems outside reserves
- Complete the listing of internationally significant wetlands to the Ramsar Convention and manage these wetlands to maintain their ecological character
- Work with the Australian Government under the National Plan for Water Security to optimise aquatic ecosystem outcomes

Objective 10.2: Effectively manage fishing impacts on aquatic biota

Key directions

- Continue to implement the Freshwater Fish Stocking Fishery Management Strategy
- Review the environmental impact of recreational fishing and modify regulations as necessary to ensure sustainability
- Provide recreational fishers with access to information on ecologically sustainable fishing practices, including minimising bycatch, litter and discarded fishing gear, and assist them to develop codes of best practice
- Ensure adequate compliance and auditing occurs

Objective 10.3: Improve management at a catchment scale

Key directions

- Ensure that landscape/catchment-scale planning instruments, such as Catchment Action Plans and Local Environment Plans, explicitly acknowledge the integral relationships between aquatic and terrestrial ecosystems and consider potential adverse impacts of poor land management activities on adjacent and downstream aquatic habitats
- Develop and encourage the adoption of sustainable land management practices that minimise the impacts on aquatic ecosystems and biodiversity
- Encourage aquatic and riparian habitat restoration initiatives

Objective 10.4: Restore degraded habitats

Key directions

- Improve provisions for the free passage of native aquatic organisms in natural waterways
- Develop catchment habitat maps indicating the extent and condition of fish habitats prior to European settlement
- Improve in-stream habitat quality by undertaking targeted rehabilitation programs
- Reduce coastal floodplain areas with high water quality risk by identifying and mapping areas of drained natural wetlands, carrying out pilot remediation projects and developing a future program of land rehabilitation
- Continue the program to reduce the degree of temperature suppression downstream of all large impoundments
- Reduce the impact of water pollution on aquatic biodiversity through regulatory controls, pollution prevention strategies and appropriate controls on land development and use

11. Marine and coastal biodiversity

The NSW marine jurisdiction extends to three nautical miles seaward of the NSW coastline and islands. NSW waters include tropical and temperate ecological communities encompassing rocky reefs, soft sediment communities, swampforests, seagrass beds, kelp beds, saltmarshes and mangroves. NSW coastlines include open waters, coastal lakes, estuaries, bays, dunes, sea cliffs and sandy beaches.

Objectives and key directions for reservation, invasive species, climate change and threatened species are found in other chapters.

Threats to marine and coastal biodiversity

The *National Land and Water Resources Audit* (NLWRA) assessment of NSW estuaries in 2000 found that only 14 of 133 NSW estuaries were in 'near-pristine' condition, while 34 were assessed as 'extensively modified' (NLWRA 2001). In 2002, the NSW Healthy Rivers Commission reported that 31% of coastal lakes were 'moderately' or 'severely' affected by human pressures (HRC 2002). Seagrasses, considered a vital ecological component of NSW estuaries, have exhibited an overall decline in distribution over the last 20 years. Saltmarsh ecosystems are being replaced by mangroves due to sea level rise, reducing the area available for birds which use saltmarshes (Straw 1999; Straw 2000; Saintilan 2003). Climate change is likely to be a contributing factor in some cases (Saintilan & Williams 1999).

Marine waters are generally considered to be in better ecological condition than estuaries (DEC 2006b). However some specific coastal areas, mainly adjacent to urban and industrial sites, are at a high risk of biodiversity decline due primarily to impacts from point-source pollution and intense recreational use, including fishing (DEC 2006b).

A range of marine protected areas have been established in coastal, estuarine and oceanic areas of NSW to protect biodiversity and marine habitats, and help ensure that marine resources are used in a sustainable manner. These areas range from small, highly-protected areas focusing on the protection of certain species or a community to large multiple-use areas that include complex ecosystems and habitats. They include aquatic reserves, marine parks and marine components of national parks and nature reserves (see Figure 10).

Pollution and eutrophication

Land use along the NSW coast (including intensification of rural land use, drainage of wetlands, urban growth and recreational activity) is affecting marine and coastal biodiversity, particularly estuarine ecosystems. Large point-source discharges are generally controlled by licences issued under the *Protection of the Environment Operations Act 1997*. However diffuse pollution, such as stormwater runoff, remains a problem, leading to eutrophication (oxygen depletion), sedimentation and increased turbidity, among others. Diffuse sources of pollution need to be identified and managed through education, catchment protection and incentives to reduce their impact.



(all W. Reynolds)

(B. Crombie, DEC)

Coastal floodplain drainage and the disturbance of acid sulfate soils have caused the degradation and loss of estuarine ecosystems. The NSW Government has a program to remediate acid sulfate soil hotspot areas, but the most effective tool to date has been to minimise disturbance of acid sulfate soils and restore natural drainage patterns where disturbed.

Use of resources

Historically, resource use in our coastal and marine environments, particularly large-scale commercial and recreational fishing, has been a contributor to biodiversity decline. Reduction in the stocks and size range of predatory species can affect ecosystems and habitats through alterations to food webs and species interaction. Commercial fish harvest levels are managed through licensing requirements and recreational fishing is controlled by limits on the size of bags and fish.

While there is evidence of stock declines in many marine and estuarine fisheries across NSW, there is considerable uncertainty in most stock assessments to date. There is a need for better information about the biological and behavioural characteristics of both commercially targeted species and recreationally targeted species, as well as the roles they play in ecosystem function.

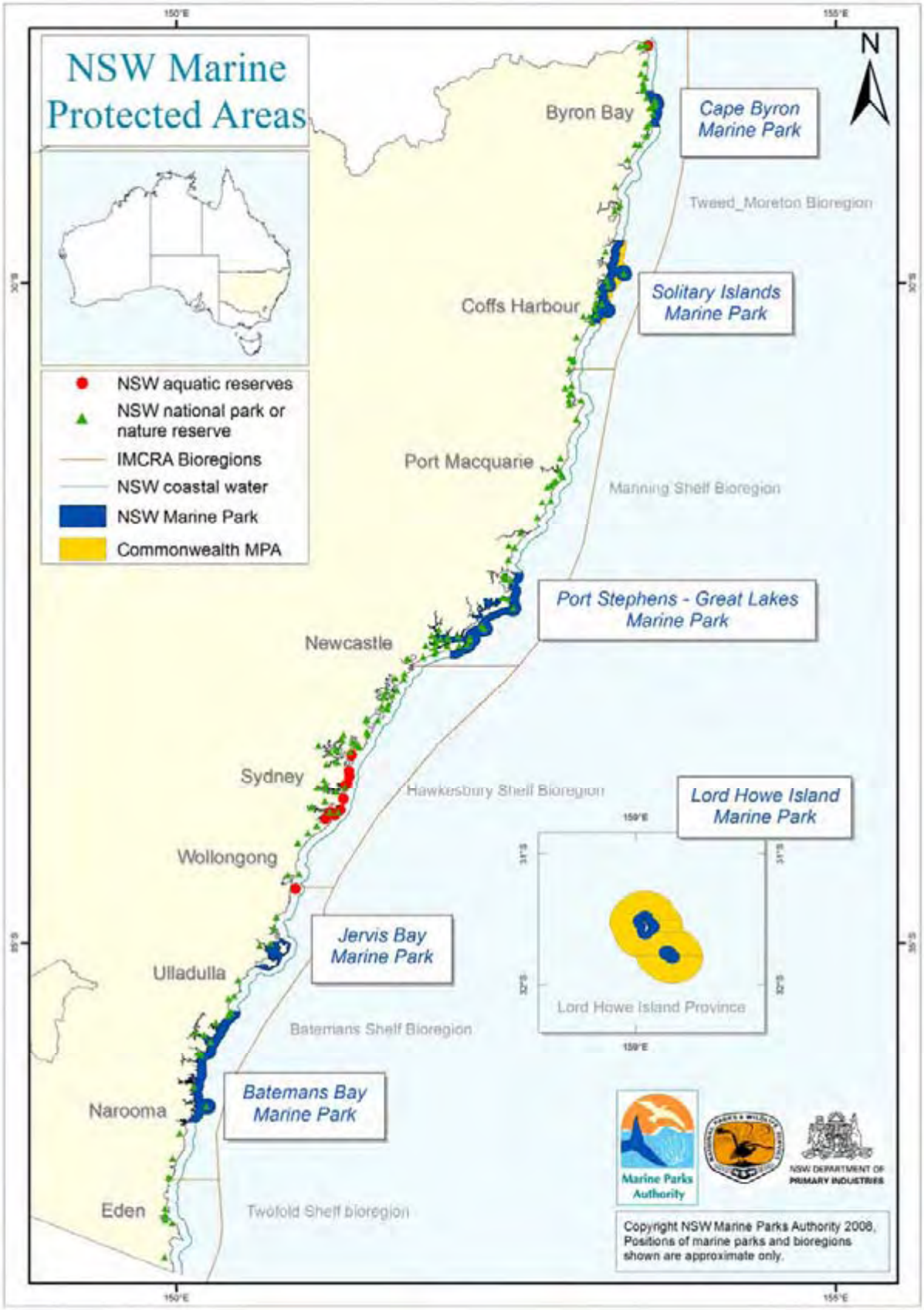
Alterations of physical habitat

Physical habitats are altered and destroyed in many ways. Foreshores have been replaced by seawalls, intertidal saltmarshes and mangroves have been infilled, and activities such as trawling, dredging and mining are altering habitat. In addition, modification of the entrance to coastal waterways alters tidal flow and salinity regimes within estuaries.

The spread of development on the NSW coast and the intensity of development in large coastal cities are contributing to habitat alteration.

We are interested in your comments and suggestions for the conservation of coastal and marine biodiversity.

Figure 10 NSW marine protected areas



Source: DECC and DPI GIS layers, 2008

Objectives

Objective 11.1: Integrate coastal zone management

Key directions

- Reduce land-based sources of pollution in marine protected areas and other high-conservation-value marine and coastal habitats
- Integrate management of the coastal reserve system and marine protected areas
- Develop and implement coastal zone management plans and restore degraded coastal habitats
- Support decreased point-source discharge to coastal waters through the reuse of sewage and wastewater and stormwater recycling
- Encourage and support activities which rehabilitate coastal floodplains, wetlands and acid sulfate soil hotspots

Objective 11.2: Promote the adoption of sustainable fishing practices

Key directions

- Continue to implement fishery management strategies to ensure environmentally sustainable practices for all commercial and recreational fishing
- Continue to monitor fish stocks and, where indicated, revise regulations and policies that control harvest levels to ensure sustainability
- Promote the use of techniques and catch levels that minimise adverse impacts on marine and coastal biodiversity
- Assess the effectiveness of protected areas as harvest refuges to determine their value in contributing to the productivity of stocks of commercially important species

Objective 11.3: Improve public knowledge and strengthen community involvement in marine and coastal biodiversity conservation initiatives

Key directions

- Invest in targeted education and awareness programs, focusing on pollution from vessels and shore, discarded fishing equipment, recreational boating impacts and stormwater
- Improve data access to assist community groups and local government with planning and conservation activities
- Continue to provide fishers with information on ecologically sustainable fishing practices and work with industry to develop and implement codes of best practice
- Invest in strategies and incentives to promote community participation in the adoption and implementation of best estuary management practices
- Strengthen working relationships with Catchment Management Authorities, local government authorities and non-government organisations with interests in marine and estuarine biodiversity conservation
- Continue development of robust, reliable resource assessment methodology for commercially and recreationally harvested species

12. Conservation and use of genetic resources

This chapter addresses the third component in most definitions of biodiversity: genetic diversity. While it is the least well-known and is often subsumed in a species-centred approach, consideration of genetic diversity is important in ensuring that the fundamental driver for evolution is not overlooked. Issues covered include the implications of loss of genetic diversity, the importance of micro-biodiversity, the commercial potential and the policy framework for gene-based research and the role of *ex situ* conservation.

Importance of genetic diversity for conservation

Genetic diversity of species is required to ensure their long-term viability. Modification of natural environments, population fragmentation, introduced species, over-exploitation, pollution and climate change are all contributing to the loss of biodiversity, including the loss of genetic diversity. Most significant is the extent of displacement by human activity and settlement of natural ecosystems and biota from large areas and the fragmentation of remaining ecosystems. This has its most noticeable impacts in the loss of large species such as mammals. Concurrent with this is loss of biodiversity across all levels, including small and less well-known species, as well as the loss of the genetic variation which exists within species and provides the foundation for their future adaptation and evolution.

Increased inbreeding that occurs in small populations reduces the fitness and capacity of a species to adapt to changing conditions compared with large populations. Conserving the genetic diversity of native species needs to occur at the levels of ecosystems, species, meta-populations and through maintenance of gene flows between populations and meta-populations within species. It is also an important consideration for the sustainable harvesting of native species, and reintroduction programs for them.

Microbial biodiversity is also important in ecosystem processes. It constitutes the vast majority of global biodiversity and needs to be considered in conservation programs. Soil biodiversity contains a very large proportion of total biodiversity, and its maintenance across landscapes is of vital importance, with benefits for both conservation and agricultural production.

Use of genetic resources

The commercial value of biodiversity to society is gradually becoming recognised. Antibiotics derived from fungal biota revolutionised medicine in the twentieth century and the suite of potential future applications from bio-prospecting and genetic discoveries is growing almost as quickly as the genetic wealth of biota is disappearing.

(P. Meeks, DECC)

(DECC)

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An integrated policy is needed for the sustainable management of genetic material in NSW, including specific components dealing with bio-prospecting activities, indigenous ownership, microbial diversity, native and non-native species, and the equitable distribution of benefits arising from use. This policy will be consistent with the agreed *Nationally consistent approach for access to and the utilisation of Australia's native genetic and biochemical resources* (NRMMC 2002).

The current policy is a mixture of state and national guidelines and legislative requirements, such as the licensing rules for protected species under the *National Parks and Wildlife Act 1974*. Issues such as intellectual property and the shared rights between those who own resources and those who undertake research efforts, require greater clarification however.

Ex situ biodiversity conservation

'*Ex situ*' (off-site) conservation refers to the capture and storage away from the natural habitat of either whole living organisms, natural propagules or components of genomes. The degree to which any of these will contribute directly to actual conservation is governed by:

- the initial and sustained genetic representativeness of the *ex situ* population
- the ability to maintain evolutionary 'fitness' and evolutionary potential, including the capacity for indefinite reproduction of the *ex situ* populations
- the need for artificial intervention in the breeding process
- the likelihood of the *ex situ* population being used effectively in either stocking enhancements or reintroductions to the wild.

Ex situ conservation is sometimes thought of as a last resort means of 'saving' species, through their indefinite preservation off-site. Without a clear ability to undertake reintroduction to the wild however, this is not a meaningful form of conservation. Although marginally better than extinction, the species is wholly dependent on the vagaries of human systems of maintenance, and is likely to dwindle to a very narrow genetic base, with prospects for reintroduction to the wild diminishing rapidly. *Ex situ* conservation needs to be considered a 'high-risk insurance policy'. It should be used only where the broadest practicable samples of a species are able to be kept *ex situ*, against a perceived threat to the species in the wild, with appropriate protection of the remaining wild populations and a definite intention to use the *ex situ* stock to augment wild populations or for reintroductions as soon as possible. Constraints on the success of *ex situ* conservation include:

- over-estimating present and future abilities to re-establish wild populations free from the threats which caused them to decline
- under-estimating the complexity and logistical difficulties of identifying and maintaining adequate samples of genetic representativeness
- uncertainty about whether a species can be re-established *in situ* where its native ecosystem either remains severely disrupted or lost, or may lack crucial but unknown symbionts or facilitators (such as mycorrhizal fungi, pollinators, dispersal vectors), and for animals where a functioning population is essential for behavioural development.

The following principles should guide *ex situ* actions:

- *Ex situ* maintenance is not a substitute for *in situ* conservation.
- Proposed *ex situ* actions require detailed and externally refereed planning, done as part of recovery planning except in emergency situations.
- *Ex situ* actions are likely to be most effective where they are directly supportive of *in situ* actions in the short to medium term.
- Priority is given to situations where failure of *in situ* techniques is likely.

- *Ex situ* actions require integration of research and conservation actions across the full range of areas including seedbanking, microbial culturing, captive breeding, symbiosis and syn-ecological research, and threat-process amelioration. This integrated suite of programs is necessary to generate the knowledge needed for reliable *ex situ* storage of the many organisms that may require it at some stage before new survival equilibria are achieved.

We recognise that conservation of genetic diversity is complex and technically challenging but crucial for ongoing evolutionary development. We are interested in your views and suggestions for the conservation of genetic diversity.

Objectives

Objective 12.1: Develop an improved policy framework for sustainable management of endemic genetic resources

Key directions

- Review and where necessary amend NSW policy in light of the agreed national approach and new understanding
- Identify and address gaps in the legislative framework for management of endemic genetic resources

Objective 12.2: Maintain gene flow in fragmented landscapes

Key directions

- Develop techniques to monitor gene flows and investigate the most effective ways of maintaining genetic exchange between fragmented populations and assemblages

Objective 12.3: Develop improved information about and support techniques for conservation of microbial biodiversity

Key directions

- Support research into endemic microbial taxonomy, ecology, ecosystem functions and conservation
- Support conservation of soil biodiversity in agricultural landscapes, through the use of techniques which maximise soil organic matter and minimise changes to soil structure and composition

Objective 12.4: Maximise conservation of small and localised biodiversity, including local endemic plants, mosses, lichens, invertebrates and microbes

Key directions

- Develop a multi-tenure small-site protected area network, as an adjunct to the existing comprehensive, adequate and representative (CAR) reserve system, in cooperation with local government and community conservation networks

Objective 12.5: Establish and maintain a comprehensive ex situ *conservation program*

Key directions

- Establish a clear policy framework for where *ex situ* conservation is needed
- In partnership with other relevant bodies, develop a proposal for a comprehensive *ex situ* conservation and gene banking scheme

- For current highly threatened taxa where other conservation options are not likely to be effective, enter into arrangements for *ex situ* conservation, based on comprehensive planning and peer review

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