



Australian Government

**Sustainability, Environment, Water,
Population and Communities portfolio**

Biodiversity in a Changing Climate:

*A submission to the inquiry by the House of
Representatives Standing Committee on Climate
Change, Environment and the Arts.*

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Introduction

The Sustainability, Environment, Water, Population and Communities portfolio (the portfolio) is responsible for implementing the Australian Government's policies to protect our environment, water and heritage, and to promote a sustainable way of life. Climate change poses a growing challenge for governments as we work to conserve and safeguard Australia's biodiversity and to support the wellbeing of our communities.

The portfolio welcomes this inquiry into Australia's biodiversity in a changing climate. It is an opportunity to raise public awareness of the ways in which our biodiversity may be impacted by climate change and to consider the implications for our industries and economy, our cultural identity, health and wellbeing. The inquiry also provides for consideration of the available tools, strategies and mechanisms to support the adaptive capacity of the natural environment.

This inquiry will go some way towards responding to the recommendation from Australia's Biodiversity and Climate Change, Summary for Policy Makers (2009):

A national discourse...should build a much broader and deeper base of support across Australian society for biodiversity conservation, and for goals that are appropriate in a changing climate. In particular, biodiversity education, policy and management should be reoriented...towards: (i) maintaining well-functioning ecosystems of sometimes novel composition that continue to deliver ecosystem services; and (ii) maximizing...diversity.¹

This submission highlights that communities will be affected by biodiversity decline attributable to the direct and indirect impacts of unmitigated climate change. For example, without sufficient mitigation and adaptation action, our fisheries, tourism industry, and coastal and rural communities may be negatively affected. More broadly, the loss or decline of species and ecosystems could affect the cultural identity and well-being of all Australians, particularly Indigenous Australians. Even with mitigation, some vulnerable ecosystems - such as the Great Barrier Reef, Kakadu, the Wet Tropics of Queensland and our Antarctic territories - will be impacted in some way. A better understanding of the quantifiable value of Australian ecosystems to our society will provide a foothold for concerted, national action to build the resilience of biodiversity and communities.

The scope of the challenge

Impacts on biodiversity in Australia and its territories

Biodiversity decline includes the loss and simplification of ecosystems, decline in the number and range of species in a particular region and loss of genetic diversity within populations of plants, animals and other organisms. Australia has suffered the largest documented decline in biodiversity of any continent over the past 200 years.

Biodiversity decline is caused by a range of threatening processes. The major historical and immediate threats to the biodiversity of our land and inland waters are habitat loss (largely a result of land clearing for agricultural use and urban settlement) and weeds and feral animals. These threats are intensified by added stressors, which may include changed fire regimes, unsustainable resource use, pollution and nutrient run-off. Threats tend to be cumulative in that they compound each other and cause decline faster and further than if they acted alone.

In April 2001, a new threat was added to the list of key threatening processes under the EPBC Act: 'loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases'. Compared with previous natural climate changes over geological time scales, human-induced climate change presents a more potent risk to the environment. There is less potential for natural systems to successfully adapt because climate change is taking place rapidly (for example, the linear warming trend of the past 50 years was nearly double that of the past 100 years²), and the health and resilience of natural systems is already compromised due to the cumulative impacts of other stressors. The 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report identified natural ecosystems as the sector most vulnerable to climate change in our region.³ Climate change will affect biodiversity directly (such as through changing temperatures, sea level rise, variations in rainfall and changes in the frequency and intensity of extreme weather events) and indirectly (such as through changing fire regimes and an expansion of the range of favourable habitats for introduced species).

The IPCC predicts that climate change will result in a significant loss of biodiversity within the next decade in some ecologically rich sites –including the Great Barrier Reef and Wet Tropics of Queensland. Other sites at risk include the Kakadu wetlands, south-western Australia, the sub-Antarctic islands and alpine areas. Impacts are likely to be felt in the short term irrespective of the level of global emissions⁴ (in other words, due to change that is already locked into the climate system). Scientists predict that if greenhouse gases are stabilised at 550 parts per million carbon dioxide-equivalent (ppm CO₂-e) by 2100 the Great Barrier Reef as we know it will disappear.⁵

Impacts of climate change on Antarctic and Southern Ocean ecosystems include changes to marine food chains through a decrease in sea ice extent, reduction in salinity of coastal waters and ocean acidification. Penguin populations in some areas of Antarctica are decreasing rapidly.⁶ Increasing acidity in the Southern Ocean threatens animals and plants⁷ that use calcium carbonate for shells or other structures. Shell weights of some creatures have already dropped.⁸ If the trend towards increasing ocean acidity continues, larval development of krill will be totally disrupted.⁹ Krill are the largest source of animal protein in the Southern Ocean. If krill populations are undermined, this will have implications for the food chain, not only for whales, penguins and seals, but also for the human population.

How climate change impacts on biodiversity may affect society

Biodiversity provides many ecosystem services essential to human existence and the enjoyment of life. The 2005 UN Millennium Ecosystem Assessment framework identified ecosystem services in four categories: provisioning services, such as food and water; regulating services such as pollination and the control of floods and diseases; supporting services such as nutrient cycling and climate regulation that maintain the conditions for life on Earth; and cultural services, such as spiritual, recreational, and cultural benefits. These ecosystem services can be considered part of the overall stock of capital resources that contribute to the wellbeing of each individual in society.¹⁰ However, the unique characteristics of our 'natural capital' assets need to be recognised:

"Like reproducible capital assets (roads, buildings, and machinery), ecosystems depreciate if they are misused or are overused. But they differ from reproducible capital assets in three ways: (1) depreciation of natural capital is frequently irreversible (or at best the systems take a long time to recover), (2) except in a very limited sense, it isn't possible to replace a depleted or degraded ecosystem by a new one, and (3) ecosystems can collapse abruptly, without much prior warning".¹¹

Like other complex systems, ecosystems can appear to be functioning well but suddenly collapse because the supporting base has eroded without noticeable warning signs.¹² The impacts of climate

change on Australian ecosystems may be dire. Dramatic and rapid changes to ecosystems are likely to diminish their capacity to provide certain ecosystem services that support our wellbeing.

Impacts on coastal communities

The impact of climate change on coastal communities includes the threat of inundation, erosion and effects on water quality and supply from rising sea levels and extreme weather events. These threats are likely to be exacerbated by the damage to ecosystems such as mangroves and coral reefs, which provide natural coastline protection. These ecosystems are also important habitats for a range of species of commercial and recreational significance.

Health impacts

Changes to temperature and rainfall patterns in areas such as Kakadu may lead to an increase in the transmission of diseases by insects (and especially mosquitoes) such as Ross River virus, malaria, encephalitis and melioidosis.¹³ Warmer temperatures and higher rainfall may also increase the occurrence of food and waterborne diseases.¹⁴

Impacts on fishing and aquaculture industries

The Australian fishing and aquaculture industries contribute around \$2 billion to our economy per year. Expected climate-induced changes to coastal habitats, ocean temperature, currents, winds, nutrient supply, rainfall, ocean chemistry and extreme weather conditions from climate change will affect Australia's fisheries.¹⁵ For example, changes in the rainfall pattern in Northern Australia are likely to affect catches of prawns, barramundi and mud crabs as harvesting of these species is dependent on patterns of summer rainfall, while extended periods of extreme temperature in shallow estuarine waters may affect the distribution of prawn nursery habitat such as seagrass.¹⁶ Degradation and migration of estuaries and mangroves, which provide critical nursery habitat for fish and other marine life, may also affect the abundance and distribution of commercially important species.

An increase in water temperature has resulted in the strengthening of the southward flow of the East Australian current: warmer, saltier water is now found 350 km further south than was the case sixty years ago.¹⁷ This trend is linked to the southward migration of a predatory sea urchin to Tasmanian waters. In areas where the sea urchins migrate, kelp forests are destroyed and the biodiversity dramatically reduced, resulting in reduced incidence of abalone¹⁸ and other important fishery species. The migration of sea urchin coupled with an increase in water temperature is also likely to impact the Tasmanian rock lobster industry, worth \$72 million per year. The current is expected to strengthen a further 20 per cent by 2100.¹⁹

Impacts on agriculture and rural communities

Biodiversity plays a crucial role in maintaining the productive capacity of our landscape. Biodiversity can act as a buffer against a harsh and variable climate by binding and nourishing soils and filtering streams and wetlands. Loss of biodiversity, declines in river and wetland health, reduced water quality and quantity, reduced flood control, increased erosion and reduced productivity are some of the challenges presented by a changing climate. For example, in the western regions of inland South-eastern Australia, increased temperature and evaporation is likely to lead to drier soil conditions throughout the year and reduced vegetation cover caused by poorer growing conditions is likely to lead to increased soil erosion. Despite the likelihood of drier conditions for much of the year, flood-producing rainfall events are likely to increase in frequency and intensity in these areas, increasing erosion and placing further stress on the systems.²⁰ The effects of climate change will put pressure on production, which may in turn exacerbate the stress on biodiversity.

Impacts on the tourism industry

“Nature in Australia” was identified as the foremost experience type that could motivate international travellers to visit Australia,²¹ so it is not surprising that 64 per cent of international visitors participate in a nature-based experience.²² Any significant changes to Australia’s biodiversity or natural environment can be expected to have a direct impact on the tourism industry. For example, 5.8 million visitor nights (38 per cent of total inbound tourism) are spent in tourism regions regarded as extremely vulnerable to the effects of climate change.²³

Tourism on the Great Barrier Reef is threatened by the loss of the reef’s biodiversity. Rising water temperature, ocean acidification and declining water quality cause physiological stress in corals (e.g. coral bleaching) and may lead to mortality, which, in turn, reduces the diversity of coral reef systems and their attraction for tourists. In dollar terms, the value of the reef to the Australian economy has been assessed as \$51 billion; the cost of total coral mortality could erode \$38 billion of that value, approximately 3.5 per cent of gross domestic product.²⁴

The freshwater wetlands of Kakadu National Park in the Northern Territory are vulnerable to salt water intrusion caused by rising sea levels. Damage to the wetlands and the flora and fauna it supports would likely affect tourism numbers.²⁵

Rising temperatures have the potential to impact rainforest ecosystems that carry significant attraction for tourists. A 1°C rise in temperature compared to 1990 would greatly reduce the area of cloud forest and other highland rainforest across the Wet Tropics of Queensland, whilst a 2°C rise could force all endemic Australian tropical rainforest vertebrates, including ringtail possums and tree kangaroos, and many insects to extinction.²⁶ On Lord Howe Island, climate change could increase the altitude of the cloud layer through rising sea surface temperatures. The cloud layer maintains the humidity and rainfall required by about 86 per cent of the island’s endemic plant species.²⁷

Impacts on Indigenous communities

Environment and a sense of country are intrinsic to Indigenous identity and law - which celebrates ancestors and connects people to the past. Remote Indigenous and Torres Strait Islander communities are particularly reliant on healthy ecosystems for their traditional culture, subsistence and livelihoods.

In the Torres Strait, expected effects of climate change include changes to rainfall patterns, hotter weather and sea level rises. These changes may affect traditional and commercial fishing, hunting and subsistence farming in areas already vulnerable due to socioeconomic factors and remoteness.²⁸

Changes to salt and freshwater wetlands in Kakadu National Park caused by saltwater intrusion have already been observed, and increases in average temperatures of 2-3°C (compared to 1990) could result in losses of up to 80 per cent of freshwater wetlands in Kakadu.²⁹ Saltwater intrusion will impact on freshwater dependent wildlife and traditional food resources such as magpie geese, barramundi and turtles.³⁰ Sea level rise may also affect mangrove ecosystems in Northern Australia, which are very important sources of food for Indigenous people and a basis for traditional cultural activities and habitat for totemic species.³¹

The link between healthy landscapes and Indigenous people’s well-being is well documented. The impact of climate change on sacred sites and traditional lands may adversely affect communities’ mental and physical well-being.³²

Cultural impacts more broadly

Declining biodiversity threatens to diminish Australians’ culture and lifestyle. Our unique environment helps define what it means to be Australian. Our biodiversity and superb natural areas inspire us and enrich us spiritually and artistically. In the face of increasing urbanisation, we are placing higher store on the value of natural places to relax and recharge the spirit, and for recreation

and exercise. Although the full range of impacts is difficult to quantify, the declining quality of our natural systems under unmitigated climate change will undoubtedly reduce the liveability of our communities.

Policy and management responses

Promoting resilience and connectivity

Strategic and innovative approaches to conservation management and planning will be required if the health and resilience of Australia's nationally important ecosystems are to be maintained. Australia's *Biodiversity Conservation Strategy 2010-30* is the national policy framework for action on biodiversity over the next 20 years. The challenge to build ecological resilience is one of the Strategy's three priorities.

Recent CSIRO modelling suggests that major changes in Australia's biomes could occur within the next decades.³³ Novel ecosystems may emerge, featuring a new mix of species, interactions and functions. At the same time, climate change may lead to considerable land use change, with the possible transition from grazing to cropping in some regions of Northern Australia.³⁴ Management objectives will need to be reoriented from preserving all species and current compositions to maintaining a diversity of well-functioning ecosystems that can support a mix of ecological services and maintain evolutionary processes.

Given the uncertainty around the localised effects of climate change and the impacts on particular species, focussing on the resilience of ecosystems is likely to be a more effective approach than individual adaptation measures targeting species or localised effects. The IPCC Fourth Assessment Report (2007) describes resilience as "the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change".³⁵ Systems that are intact and biologically healthy are likely to have a greater capacity to resist, recover from or moderate changes imposed by catastrophic or ongoing pressures. Conversely, a lack of diversity in an ecosystem (e.g. due to species decline) is thought to increase vulnerability to climate change, as degraded systems have less options for coping with climate-related shocks and stresses. Resilience in many systems may be strengthened by removing or moderating existing drivers of biodiversity decline. The emerging theory of resilience thinking for climate change adaptation may yield new insights and approaches that can be applied in environmental policy and practice.

A landscape-scale approach is based on enhancing habitat connectivity, and supporting the resilience and adaptive capacity of ecosystems to climate change and other threats. Landscape scale management integrates management of ecosystems with human land uses. By understanding the relationships between land uses and ecosystem functions at the regional level, land managers and decision makers are better able to maintain ecosystem services and to avoid driving systems beyond the point at which they cannot cope with further change.

Christmas Island's Red Crab Migration

Christmas Island supports ecosystems and species of international conservation and scientific significance, which provide socio-economic benefits for the Christmas Island and Australian communities. The island is famous for the annual red crab migration, when tens of millions of crabs migrate from the rainforest to the sea. In recognition of the unique environmental values of Christmas Island, a National Park was proclaimed in 1980 and covers approximately 63 per cent of the island, as well as an important marine area.

Christmas Island's ecosystems have been under threat from introduced species and the impacts of mining. Climate change is likely to exacerbate existing problems. It is likely to cause a decline in red crab abundance through:

- Disruption to their migration, which is triggered by the arrival of the first rains of the wet season³⁶. Climate change is expected to mean a less predictable onset of the monsoon.
- An increase in the abundance of the introduced yellow crazy ant. Crazy ants spray formic acid as a defence mechanism, which causes dramatic mortality in red crabs.

Red crabs are a keystone species; their removal would result in significant changes in forest ecosystem structure and function.

To address the decline in the abundance and distribution of red crabs, Parks Australia is undertaking a suite of programs including:

- a program to control crazy ants; and
- strategies to protect the crabs from being killed by vehicles (through closing roads and constructing red crab underpasses and fences).

Parks Australia also undertakes programs such as weed management, mine site rehabilitation and native reptile recovery programs. These activities should build the resilience of Christmas Island's environment to the impacts of climate change.

The Australian Government's core environmental protection legislation, the EPBC Act, provides mechanisms to manage the impacts of land use change on the resilience of ecosystems. The EPBC Act allows the Australian Government to undertake strategic assessments at the regional, landscape or ecosystem scale, which provides the capacity to address cumulative impacts of development and to manage habitat connectivity. Assessments typically identify environmental assets needed to maintain functioning ecosystems and biodiversity, so that new developments can be planned to minimise environmental impacts. Several strategic assessments have been completed, including for Melbourne's urban growth boundary, which will entail not only the construction of 284,000 new dwellings but also the creation of a new 15,000 ha national park for the conservation of threatened ecosystems.

The portfolio's programs taking a landscape scale approach to biodiversity conservation include Caring for our Country, the National Wildlife Corridors Plan and the Environmental Stewardship Program.

By connecting existing public reserves and other protected areas with suitably managed private land, it is possible to enhance the resilience of the present conservation network and improve its capacity to cope with climate change. The most valuable linkages are those that maintain contiguous habitats or continuity along an environmental gradient.³⁷ In enhancing landscape connectivity, it will be

particularly important to identify and appropriately manage refuges - areas likely to evade changes in the surrounding environment.³⁸

Australia's National Reserve System (NRS) is a key element in national efforts to protect terrestrial and freshwater biodiversity. The NRS Strategy³⁹ recognises the importance of linking with other habitat protection schemes to maintain ecological processes across the landscape and to support adaptation to a changing climate. Protected areas can help ecosystems to withstand or adapt to the impacts of climate change through promoting connectivity and providing refuges. The NRS, including Indigenous Protected Areas and Commonwealth Marine Protected Areas, is being implemented at the landscape-/seascape-scale through consideration of the comprehensiveness, adequacy and representativeness of the protected area estate. Work by CSIRO has concluded that such an approach is one of the best ways to support adaptation of biodiversity to climate change.

Marine Bioregional Planning

The Government's objectives in managing Commonwealth marine areas are to:

- conserve biodiversity and maintain ecosystem health;
- ensure the recovery and protection of threatened species; and
- improve our understanding of biodiversity and ecosystems and the pressures they face.

The Marine Bioregional Planning Program aims to improve the management of whole marine ecosystems, including the interactions of people and industry with marine environments and species. Marine bioregional plans (MBPs) will enable decision-makers in government and industry to consider the interactions between proposed activities and conservation values, and cumulative impacts. MBPs will:

- support strategic, consistent and informed decision-making under Commonwealth legislation in relation to Commonwealth marine areas;
- support efficient administration of the EPBC Act to promote the ecologically sustainable use of the marine environment and its resources; and
- provide a framework for strategic intervention and investment by government to meet its policy objectives and statutory responsibilities.

The MBP program is also being used to identify potential new marine reserves that will form part of the National Representative System of Marine Protected Areas (under development by the Commonwealth, state and Northern Territory governments). Marine reserves will help maintain the resilience of marine systems in the face of climate change.

Promoting the sustainable use of natural resources

Market-based mechanisms

Full valuation of biodiversity resides in understanding the tangible goods and services that ecosystems provide, while appreciating the often-irreversible nature of its demise. In this regard, there is further scope to measure the full value of ecosystem services to Australian society. For example, market based instruments such as environmental offsets, water pricing, and conservation tenders are providing new opportunities to value ecosystem services.

Appropriate allocation of water is a key step in balancing social, environmental and economic outcomes in the Murray Darling Basin. The Commonwealth's efforts to protect freshwater-dependent biodiversity include the recent acquisition of more than 1000 GL of water entitlements,

which will be used on an ongoing basis to protect or restore rivers and wetlands in the Basin. In addition to mitigating the impacts of river regulation, the active use of environmental water will help Basin water resources withstand potential further reductions in water availability due to climate change. By providing water to improve the health of environmental assets, the Commonwealth Environmental Water Holder and other environmental water holders are helping to preserve habitats that sustain freshwater biodiversity, while also enhancing ecosystem resilience and connectivity.

Under the new Carbon Farming Initiative (which is linked to the Government's Clean Energy Future plan), landholders can earn carbon credits by reducing emissions from agriculture and increasing the carbon stored in forests and other ecosystems. These credits can then be sold to companies with obligations under the carbon price mechanism, or to those who wish to voluntarily offset their greenhouse gas emissions. Carbon Farming Initiative projects that provide co-benefits for biodiversity will be able to advertise these credentials in order to seek a premium price for their carbon credits.

The Government's Clean Energy Future plan also includes a complementary Biodiversity Fund, worth almost \$1 billion over its first six years. The fund will support landholders to undertake projects that establish, restore, protect or manage biodiverse carbon stores in targeted areas of the landscape. It is intended that this financial incentive for landholders will enhance the environmental outcomes of carbon farming projects and improve the resilience of Australia's species to the impacts of climate change.

Information, tools and monitoring

A significant amount of work has been done to assess the risk of climate change and management implications for Australian biodiversity. Publications include:

- *Australia's Biodiversity and Climate Change: a strategic assessment of the vulnerability of Australia's biodiversity to climate change* (Steffen et al, 2009)
- *Implications of Climate Change for Australia's National Reserve System: A Preliminary Assessment* (Dunlop and Brown, 2008)
- *Implications of Climate Change for Australia's World Heritage Properties: A preliminary assessment* (Australian National University, 2009)
- *The Impacts and Management Implications of Climate Change for the Australian Government's Protected Areas* (Hyder Consulting, 2008).
- *Parks Australia Climate Change Strategic Overview 2009-14* (Director of National Parks, 2009) and subordinate park-level strategies.
- *Climate Change and the Great Barrier Reef: A Vulnerability Assessment* (Eds. Johnson and Marshall, 2007).
- *Report Card of Marine Climate Change for Australia* (Eds. Poloczanska, Hobday and Richardson, 2009).
- *Position analysis: CO₂ and climate change: ocean impacts and adaptation issues* (Antarctic Climate and Ecosystems Cooperative Research Centre, 2008).
- *Position analysis: changes to Antarctic sea ice: impacts* (Antarctic Climate and Ecosystems Cooperative Research Centre, 2009).
- *Management implications of climate change in the Antarctic region – an initial Australian assessment* (Australian Antarctic Division, Department of Environment, Water, Heritage and the Arts, 2009).

Reports such as these can provide crucial direction for the development of strategic planning frameworks and action plans.

Our knowledge of the likely impacts of climate change on ecosystems is far from complete. Although there is overwhelming evidence for the occurrence of climate change, there is uncertainty surrounding the timing, extent, and severity of impacts⁴⁰ Decision-making must manage these and other uncertainties surrounding:

- How risk can be managed across a wide range of ecosystems, sectors and communities
- What are the priority action areas, acknowledging the role that economics, politics, and community values can play in decision-making
- How to avoid maladaptation, whereby adaptation decisions fail to meet their objectives and/or increase vulnerability of other systems, groups or sectors.

It is important to build the knowledge base on climate change impacts, while providing tools to deliver this understanding to decision makers and natural resource managers so they can act based on the best available information. The Australian Government-funded National Climate Change Adaptation Research Facility has worked with stakeholders to develop and implement plans for research into marine, terrestrial and freshwater environments and their management. Further research will improve our understanding of climate change impacts, the likely responses of species and ecosystems and their outlook over time, and this knowledge can be continually incorporated into policy, planning and management practices.

The National Plan for Environmental Information, announced in 2010, is a whole-of-government initiative to improve the quality and coverage of Australia's environmental information. Through the plan, national environmental standards will be developed, potential gaps in our existing environmental information capabilities will be identified, and an Environmental Information System will be developed to collate, manage and provide public access to national environmental datasets. In its first four years, the initiative will establish the Bureau of Meteorology as the Australian Government authority for environmental information, and begin building priority national environmental datasets and the infrastructure to deliver them.

Regional Natural Resource Management plans

Regional Natural Resource Management (NRM) plans have been used as tools to guide investment across Australia's 56 NRM regions. These plans operate across industries, property boundaries and land tenures. They bring stakeholders together to deliver integrated approaches to NRM and play an important bridging role between governments and regional communities.

As part of its Clean Energy Future package, the Government recently announced around \$44 million over five years for NRM regions to plan for climate change impacts and opportunities. NRM organisations will develop plans in each region to guide the location of carbon-farming projects in the landscape to reduce carbon pollution. The Government funding will also support research and analysis to develop scenarios on regional climate change impacts that can be used for natural resource management and land use planning.

Community engagement and governance

Biodiversity decline is likely to be observed across a geographically diverse range of Australian land and seascapes, affecting the provision of locally, regionally and nationally important ecosystem services. The 2009 report *Australia's biodiversity and climate change* noted that the challenge of conserving biodiversity in the context of climate change will demand more flexible and nationally coherent governance approaches. Cumulative, piecemeal land-use decisions have the potential to

result in considerable environmental degradation – this is known as the tyranny of small decisions. Conversely, there is potential for significant positive change to emerge from actions applied in a concerted manner.

Collective action to enhance the adaptive capacity of Australia's biodiversity could focus on achieving:

- increased use of landscape land-use planning (to do this effectively, we must focus on improving the way we consider interrelationships between terrestrial, aquatic and marine ecosystems in our management and planning decisions);
- the consolidation and expansion of protected area habitats;
- appropriate landscape and seascape connectivity;
- enhanced management of non-climate related stressors (e.g. human disturbance, invasive species and bushfires); and
- detailed information on - and monitoring of – expected and observed climate change impacts and changes to species and ecosystem health and distribution.

These activities may be targeted towards protecting and enhancing:

- highly diverse and well-functioning ecosystems;
- highly valued species and ecosystems that are under threat;
- a representative array of ecosystems (e.g. that represent a range of functions or underlying environments, rather than specific species arrangements);
- biomes especially critical for resilience including refuges, nursery habitats and wildlife corridors.

The portfolio is supporting collective and focussed adaptation action by facilitating reform in this area, funding research, providing data that can underpin decision-making, and by building partnerships and agreements with governments and important stakeholders (including natural resource management bodies, industry, Indigenous groups, research organisations and private landholders.)

Managing our water resources

Under the National Water Initiative (NWI), Commonwealth and state governments have made commitments to prepare water plans with provision for the environment and deal with over-allocated and stressed ecosystems. Consistent with the NWI, the portfolio is working with the jurisdictions to develop a High Ecological Value Aquatic Ecosystem (HEVAE) Framework, to assist in identifying, classifying and managing Australia's high ecological value aquatic ecosystems.

The South Eastern Australia Climate Initiative, a multi-jurisdictional climate research initiative covering the Murray-Darling Basin, southern Victoria and southern South Australia, has confirmed that there is a link between observed changes in rainfall in south-eastern Australia and climate change.⁴¹

In the Murray-Darling Basin, the Australian Government is committed to delivering a healthy river system whilst also ensuring strong regional communities and sustainable food production. Portfolio actions underway to achieve these outcomes include:

- development of a Basin Plan by the Murray-Darling Basin Authority;
- a commitment to bridge the gap to new, lower diversion limits under the Basin Plan by a combination of investments in more efficient management and use of irrigation water, both on and off farm, the purchase of water entitlements from willing sellers; and
- assistance towards environmental works and measures.

Focussing on nationally important ecosystems

The effects of climate change will be wide-ranging, and it will be impossible to ameliorate all the impacts. Given limited resources, a strategic and priority-based approach to responding to climate change impacts **will be required, taking into account:**

- **activities** that will be the most cost effective;
- activities needed early in order to capture the opportunity to address risk or achieve benefit; and
- activities that are no-regrets/low-regrets.

Identification of especially important ecosystems can assist in targeting resources. Ecosystems identified as nationally important may be particularly valuable in terms of biodiversity, habitat essential to the survival of threatened species, economic importance, recreation, culture, or aesthetics. Some natural sites have been identified as nationally or internationally significant, including World and National Heritage sites, Ramsar Wetlands, Australian Biodiversity Hotspots, Key Ecological Features in the marine environment, and threatened ecological communities listed under the EPBC Act.*

As landscape and seascape management approaches work towards building the adaptive capacity of ecosystems on a landscape scale, ecosystems ought to be valued in terms of the functions they perform, their capacity to contribute to landscape resilience and connectivity, their importance as refuges, and their vulnerability to climate change.

Lessons learnt in the management of climate change impacts on iconic sites will be applied more broadly. Protection of representative examples of intact and functioning Australian ecosystems is fundamental to maximising the opportunities for these natural systems to adapt to climate change.

Conclusion

Biodiversity has been in a state of decline due to an array of threats, and of these climate change is the most difficult to manage. Human-induced climate change presents a potent risk to the environment. The rate of change is unprecedented in the last 10,000 years and the scale of impacts cannot be predicted with certainty. Climate change mitigation must take place on a global scale to be effective and due to the long lifespan of greenhouse gases, efforts to reduce emissions may not translate into a slowing of climate change for many years. It is now accepted that efforts to mitigate climate change will not be enough to curb it completely.

National action to support the resilience of our biodiversity and the communities that depend on it can take a variety of forms. Traditional approaches to environmental conservation, involving managing and reducing non-climate threats, reduce the cumulative stress on ecosystems. Within the last decade, there have been increasing moves towards other approaches, including landscape-scale conservation to promote connectivity and resilience, and market-based mechanisms that place an economic value on ecosystem services to promote the sustainable use of natural resources. Evidence-based policy, planning and management that harness the latest science and monitoring of

* One of our most iconic ecosystems is the Great Barrier Reef. A dedicated submission on the reef is being prepared by the Great Barrier Reef Marine Park Authority (part of the Sustainability, Environment, Water, Population and Communities portfolio).

ecosystem health are more important than ever. Effective biodiversity management and conservation will continue to require novel, strategic and innovative approaches applied at scales ranging from local planning and management through to national and international policies and cooperation.

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