Australia
State of the Environment 2011
In Brief

This is a summary of *Australia state of the environment 2011,*
which is an independent report presented to
the Australian Government Minister for Sustainability,
Environment, Water, Population and Communities

by the
State of the Environment 2011 Committee

Australian Government

**Department of Sustainability, Environment,
Water, Population and Communities**

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Foreword

The Australian environment is precious. Our ecosystems, biodiversity and heritage are vulnerable to the choices we make. At the same time, we depend on them for our survival and wellbeing. Our ecosystems, and the biodiversity they support, provide services that are fundamental to human life, such as regulation of the atmosphere, maintenance of soil fertility, food production, filtration of water and pest control. The major future drivers of change—climate change, population growth, economic development and associated consumption of natural resources, as well as the pressures that these drivers place on the environment—will need to be managed carefully if our society is to achieve a sustainable relationship with the Australian environment.

This document is a summary of a national assessment of Australia's environment, *Australia state of the environment 2011*.

The *Australia state of the environment 2011* report was prepared by an independent committee using a range of best available information to support assessments of environmental condition, pressures, management effectiveness, resilience, risks and outlooks. The report is targeted at both decision-makers and the public, and was written to:

- provide relevant, credible and useful information on environmental issues to decision-makers and the public
- increase awareness of environmental issues among decision-makers and the public
- support evidence-based environmental management decisions that lead to more sustainable use and effective conservation of our environmental resources
- identify ways in which the environmental evidence base could be strengthened.

In the report, the Australian environment is divided into nine themes representing biogeographic or conceptual aspects of the Australian environment. Each theme—atmosphere, inland water, land, marine environment, Antarctic environment, biodiversity, heritage, built environment and coasts—is assessed at a national scale following a similar approach. The main drivers of change in the Australian environment are also described and the report concludes with a discussion of opportunities and challenges associated with future reporting.

The report was presented to the Minister for Sustainability, Environment, Water, Population and Communities in December of 2011 and subsequently tabled in the Australian Parliament.

The full text of the *Australia state of the environment 2011* report is available online, along with a range of additional material, at www.environment.gov.au/soe.

Dr Tom Hatton
Chair
State of the Environment 2011 Committee

Members of the committee: Dr Steven Cork, Mr Peter Harper, Mr Robert Joy, Professor Peter Kanowski, Mr Richard Mackay, Dr Neil McKenzie, Dr Trevor Ward, Dr Barbara Wienecke (ex officio)

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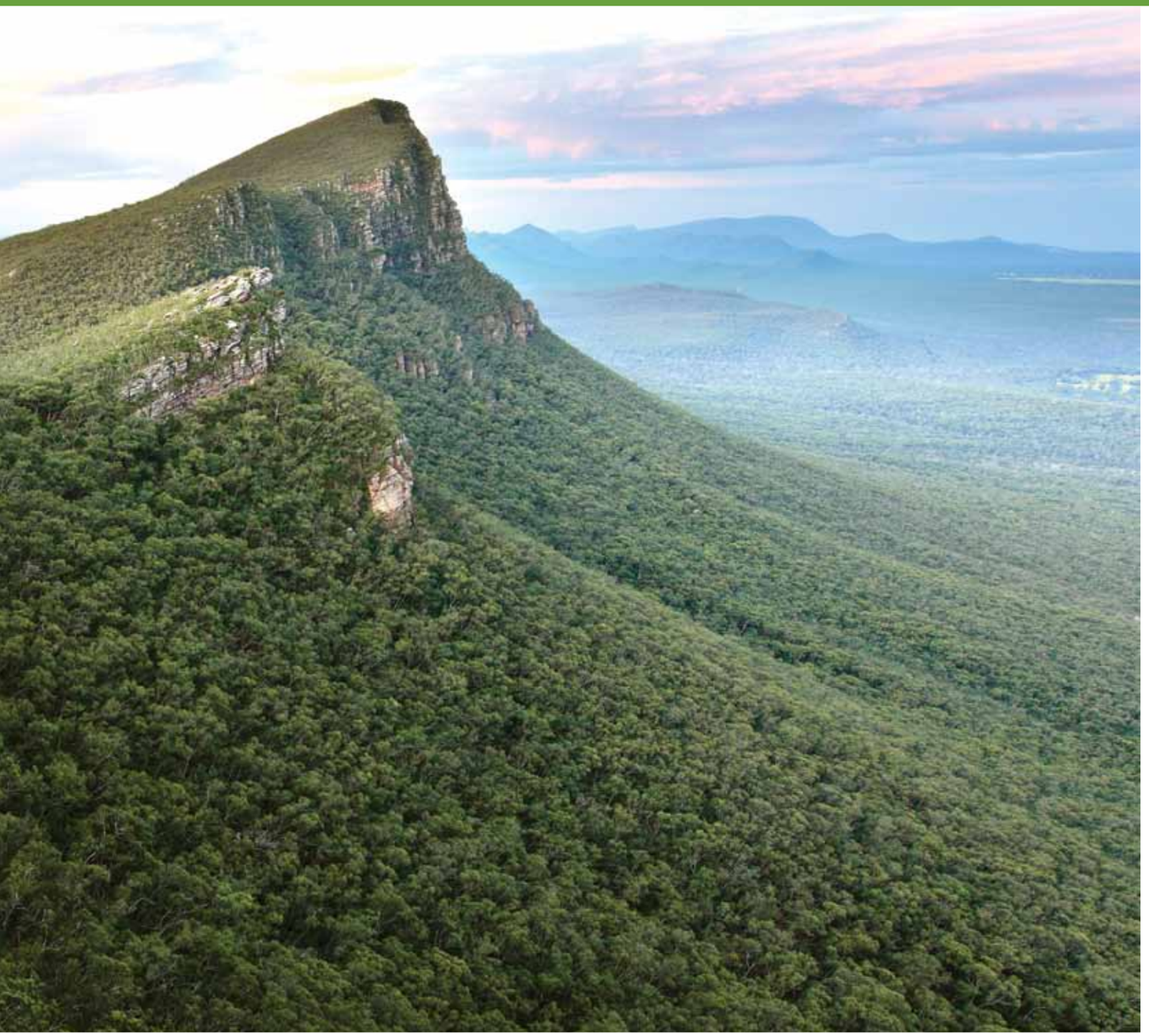


Sentinel Peak, Grampians, Victoria
Photo by Michael Boniwell

Much of Australia's environment and heritage is in good shape, or improving. Other parts are in poor condition or deteriorating. Some of the pressures on our environment arise from past decisions and practices that have left an ongoing legacy of impact. Our changing climate, and growing population and economy, are now confronting us with new challenges.

The consequences of our past environmental and heritage management are reflected in a number of environmental issues that continue to cause concern. Introductions of feral animals and weeds, widespread land clearing, drainage of wetlands, intensive harvest of fish stocks and a host of other past actions will continue to exert pressures on our environment, regardless of environmental policies and management that now prohibit or minimise such actions, and regardless of our management of the drivers of climate change, and growing population and economy. For example, even if we did not add one more person or business to the nation, the ongoing impacts of feral goats, rabbits, cane toads, land clearing and vegetation dieback would continue to be significant.

In general, environmental and heritage management in Australia reflects a sound understanding of this historical context, and translates to environmental and heritage planning with clear intent. Future environmental impacts will not necessarily be based on historical relationships between growth and resource use, biodiversity loss or environmental degradation. There is evidence that we have the means to disconnect, at least to some degree, the relationship between growth and environmental impact that has been seen in the past. While our population and economy have continued to expand, we are no longer subjecting the continent to wholesale land clearing or unmitigated industrial pollution, and sea-floor trawling is now limited. We no longer develop water resources without any reference to the needs of the environment. We attempt to recognise and protect Indigenous heritage. And while we have had only limited success in controlling introduced weeds and pests, we now take biosecurity very seriously so that we might not have as many new pests to deal with.

However, the resources required to reverse or reduce historical impacts are, in many cases, beyond the means of even a wealthy nation like Australia. Conservation investments and interventions tend to focus on our environmental and heritage assets that are of greatest value and under greatest threat. With this focus, significant restoration of the environment towards its pre-settlement condition will continue to be elusive.

If we consider the major environmental challenges we now face, the most confronting is the prospect of a changing climate. In part, this is because climate is such a direct and pervasive driver of environmental response, in part because global warming is something beyond our near-term or local control, and in part because of the uncertainties of scientific prediction and global policy. Climate change is now widely understood as a prime risk to both our environment and our society, and is clearly a major item on our national agenda. The Climate Commission's 2011 report, *Climate science, risks and responses*, makes the reality, certainty and implications of our changing climate clear and immediate.

The growth in global greenhouse gas emissions since 2005 is tracking above the middle of the Intergovernmental Panel on Climate Change's (2000) scenario range. The inertia in the atmospheric–oceanic system will drive climate change for centuries to come, even if global mitigation efforts dramatically reduce emissions. Together, these factors mean that we are facing climate consequences for the foreseeable future. Key sectors of the Australian environment are vulnerable to relatively small increases in temperature or drying, or to projected increases in sea level. There is evidence that early

action by Australia to reduce emissions and to deploy targeted adaptation strategies will be less costly than delayed action. To the extensive analyses and national dialogue on this issue, we will only add that we can expect to be surprised by both the vulnerability and resilience of different parts of our environment and heritage.

The other major drivers that put our environment and heritage at risk are the impacts of population and economic growth. These drivers are more directly under our influence than climate change. More people and more economic activity may mean more resource use, but the actual impact on the environment depends on where and how the growth occurs, and how we live our lives. Australia is making progress in lowering per-person water use and landfill waste. There is strong evidence that while our economy has grown, we are generating more wealth per unit of water or energy used. But if we are to succeed in meeting even the least ambitious greenhouse gas emission reduction targets, we need to achieve far more substantial reductions in the energy intensity of our economy.

Australians will continue to do what we can to redress the legacy of our mixed history of environmental and heritage management, while ensuring we mitigate or wisely adapt to the ongoing drivers of climate change, population growth and economic growth. To support this, we will need to choose our environmental (and sustainability) indicators with equal wisdom. These indicators need to measure the effects and effectiveness of our current and future approaches to environmental sustainability to allow us to improve our strategies.

Assessing the state of Australia's environment is inherently difficult. It is a big country, with a wide variety of ecosystems and heritage. There are many unconnected means by which we gather and store information on our environment, and accessing this information at a national scale is tremendously complicated and not always possible. We look forward to continuing improvement of environmental information systems across jurisdictions, industries and communities. There is also great value in the information we have already collected if we can access it more efficiently and effectively.

Although more and better information is essential, it is not all we need to meet our challenges. It is clear that the complexity of environmental management in a changing world demands a more integrated approach to planning, and management that focuses on achieving and maintaining environmental and heritage values.

The inadequacies of environmental data in Australia are, in part, a symptom of a lack of national coordination. Australia is a federation with nine major jurisdictions and hundreds of local authorities, plus thousands of individual government departments and nongovernment organisations. The responsibility for environmental governance is shared among the three levels of government, and with the community and private sector. Furthermore, jurisdictional divisions establish precise spatial boundaries of control, each with their own focus and purposes. Developing and implementing integrated approaches to address common objectives can therefore be challenging because the Australian environment crosses jurisdictional boundaries and its management needs rarely reflect our organisational and administrative structures.

Because of this complexity, the Australian Government has an important role to play in environmental management. This role is leadership—partly through the government's own actions and partly through national coordination. This leadership extends to priority setting, funding and handling of policy on national issues; information gathering and sharing; and coordination of programs, guidelines and standards. National programs such as the Murray–Darling Basin Plan, Caring for our Country or the National Reserve System are also important in providing overarching systems for particular aspects of our environment. The prognosis for the environment at a national level is highly dependent on how seriously the Australian Government takes its leadership role.

We can harness our increasing power to influence environmental processes to achieve positive outcomes. The key to achieving this will be national policy and management decisions that improve Australian environmental outcomes, cooperation and coordination of all governments and stakeholders, and the support of the Australian people to drive environmental change for the better.

Headlines

- Our environment is a national issue requiring national leadership and action at all levels.
- Effective environmental management requires adequate information.
- Australians cannot afford to see themselves as separate from the environment.
- Earth is warming, and it is likely that we are already seeing the effects of climate change in Australia. As the driest inhabitable continent, Australia is particularly vulnerable to climate change.
- Early action by Australia to reduce emissions and to deploy targeted adaptation strategies will be less costly than delayed action.
- Ambient air quality and air pollution management in Australia's urban centres is generally good, but the impact of urban air quality on health is still a matter of serious concern.
- Pressures of past human activities and recent droughts are affecting our inland water systems.
- Meeting our water needs will be a critical challenge.
- Australia's land environment is threatened by widespread pressures.
- Threats to our soil, including acidification, erosion and the loss of soil carbon, will increasingly affect Australia's agriculture unless carefully managed.

Snow gums, Mt Buffalo, Victoria
Photo by Mark Gray

- The overall condition of the Australian marine environment is good, but integrated management will be key to the future conservation of our ocean resources.
- The ocean climate is changing and we will need to adapt.
- The Antarctic environment is showing clear signs of climate change, which is likely to have profound effects on Antarctic species and ecosystems.
- Our unique biodiversity is in decline, and new approaches will be needed to prevent accelerating decline in many species.
- Our extraordinary and diverse natural and cultural heritage is currently in good condition, but is threatened by natural and human processes, and a lack of public sector resourcing.
- Australia's built environment faces many pressures and consumes significant natural resources, though consumption may be slowing.
- Coastal regions bring together many of the issues affecting other parts of the environment, and coordinated management will be needed to mitigate pressures.

Drivers
of Australia's environment

Observatory Hill, Sydney, New South Wales
Photo by Mark Gray

Main messages

The principal drivers of Australia's environment—and its future condition—are climate variability and change, population growth and economic growth.

Our challenge is to mitigate the degree and potential impacts of climate change, and to decouple national growth from increased pressures on our environment. There is ample historical evidence of a strong correlation between population and economic growth, and increased resource use and waste production. However, we are not necessarily bound by this history. The opportunities to decouple this relationship through innovation and improved efficiency are many and varied.

Climate variability and climate change have a direct impact on the condition of Australia's environment.

As the driest inhabitable continent, Australia is particularly vulnerable to the potential effects of climate change. We face a significant challenge in understanding the environmental implications of climate change, and how we might mitigate those impacts or adapt to them.

Australia's exposure to climate change depends on global greenhouse gas emissions.

In 2000, the Intergovernmental Panel on Climate Change developed emissions scenarios to guide global climate projections. Since 2005, global emissions of greenhouse gases have continued to track above the middle of the scenario range. Based on our current understanding of atmospheric processes, the implication is that current policies will not achieve the significant reductions needed to mitigate profound climate change.

It is likely that we are already seeing the effects of climate change in Australia.

Australian average surface temperatures rose by nearly 1 °C between 1910 and 2009. Warming was modest in the early part of this period, declined slightly between 1935 and 1950, and then rapidly increased. The decade 2000–09 was the nation's warmest on record. Some regions have had temperatures increase by 2 °C since 1960. The frequency of hot nights has increased and the frequency of cold nights has declined. Rainfall trends are more difficult to distinguish, given the large natural variability across regions and over time. During the past few decades, cool season (April to November) rainfall has largely decreased in the south-west and south-east when compared with natural variability, and winter season rainfall in the south-west of Western Australia has declined by about 15% since the mid-1970s. Climate models project that, by 2030, average annual temperatures across Australia are likely to warm by 1 °C (above 1990 temperatures), with warming of 0.7–0.9 °C in coastal areas and 1–1.2 °C inland. Drying is likely in southern areas of Australia, especially in winter, and in southern and eastern areas in spring. Changes in summer tropical rainfall in northern Australia remain highly uncertain.

Under the base scenario, Australia's population of 22.2 million people in 2010 is projected to grow to 35.9 million by 2050.

This figure may reach only 30.2 million if there is less net migration and continuing low fertility rates. The projected development of infrastructure (e.g. housing, transport, water supply, energy, communications) strongly correlates with anticipated population growth, reflecting the longstanding pattern of association between these variables. In the absence of effective policies to reduce the impacts of population growth, this will remain a good indicator of future pressures.

The Australian economy is projected to grow by 2.7% per year until 2050.

Higher labour productivity gains could increase this to 3% per year. As Australia's economy expands, it is likely that our resource consumption and waste production will also increase. However, improved efficiencies in resource use have weakened the link between economic growth and energy use over recent decades.

Drivers

Trends and impacts

The condition, trend and outlook for the Australian environment are subject to some major drivers of change. Understanding and quantifying these drivers is fundamental to understanding the past, present and future state of our environment.

Climate change is a direct driver of change. ***Population growth*** (with associated growth in the built environment) and ***economic growth*** (with associated increases in resource consumption and waste generation) are indirect drivers. As a direct driver, climate change has direct and ongoing effects on the environment—higher temperatures and changing rainfall regimes in some areas can be expected to have profound and pervasive effects on a host of natural processes that underpin the condition and trend of ecosystems. The effects of indirect drivers are mediated by other processes, including the policies, culture and technology that we bring to bear on our use of our environment. For example, population growth is likely to continue to drive the need for expanded suburban development. The size of this impact will depend on the sensitivity of planning towards local environmental assets and values, and the effectiveness of policies to improve the energy efficiency of housing and transport.

Historically, a higher population has generally translated into an amplified demand for resources, a larger physical 'footprint' for our settlements, and more waste and emissions going back into the environment. At the global scale, the Millennium Ecosystem report states that, over the past 50 years, humanity has changed ecosystems more rapidly and extensively than in any comparable time in human history, largely to meet increased demands for resources.

In the future, population and economic growth will probably still increase demand for energy and other resources, as well as increase waste generation. Alternatively, economic growth may be largely decoupled from increased consumption of resources and increased production of waste. Improvements in the efficiency of resource use have weakened the link between economic growth and energy use over recent decades. For example, tens of millions of tonnes of solid waste were successfully diverted from landfill to productive uses between 1996 and 2009, as a result of government policy (strongly influenced by a growing community desire to recycle) and improved technology. This saved large quantities of valuable materials, and significant amounts of embodied energy and water.

Changes in our economy will also change our environmental impact. Over the past century, the structure of the Australian economy changed markedly: the significance of agriculture reduced, manufacturing declined from peak levels reached in the 1950s and 1960s, and there has been a steady rise of the already dominant service sector since 1950. Since different industries exert different pressures on the environment, future structural changes in the economy can be expected to have an impact—either positive or negative—on the environment.

Understanding the trends and environmental implications of environmental drivers is fundamental to establishing what a sustainable Australia might be like. However, establishing clear relationships between drivers and environmental impacts is not easy, particularly when we are projecting outlooks. There are strong and diverse interactions among climate change, economic growth and population growth that make predictions uncertain. In addition, climate change and economic growth—and, to a smaller extent, population growth—are subject to global processes that are largely outside Australia's control.

In the short term, continued growth can be expected to further increase demand for energy and production of waste. In the long term, while significant policy and technological change (in some cases requiring global adoption) will be needed to break this relationship, there is substantial room for hope that we will be able to minimise the negative environmental impacts of a growing nation.

Wandjina rock art figures, the Kimberley, Western Australia
Photo by Nick Rains

Indigenous land and sea management

Indigenous land and sea management, also referred to as 'caring for country', includes a wide range of environmental, natural resource and cultural heritage management activities undertaken by individuals, groups and organisations across Australia. These activities have their origins in the holistic relationships between traditional Aboriginal and Torres Strait Islander societies and their customary land and sea estates—or 'country'—that have existed for at least 50 000 years. These cultural rights and practices have adapted and evolved over time and now encompass a diversity of local, regional, state, territory and national institutional arrangements. These include Indigenous employment in government agencies, such as national parks and natural resource management organisations, and increasingly, the establishment of Indigenous land and sea management agencies and ranger groups. There are now several hundred community-managed Indigenous land and sea management groups or organisations around Australia.

A planning workshop at Garmbemirri, from the Wunambal Gaambera Healthy Country Plan 2010–2020; the traditional owners used a conservation action planning process to involve relevant people (photo by the Wunambal Gaambera Aboriginal Corporation)

Indigenous land and sea management initiatives are contributing to a conservation-based economy with significant social, health and cultural benefits, especially in remote regions. All levels of government, recognising the high biodiversity and other environmental values of Indigenous management lands, have responded to caring for country initiatives through funding, partnerships and other support. Ongoing financial support and some institutional reform, including greater recognition of Indigenous management of sea country, will be required to enable these opportunities to reach their full potential.

Atmosphere

Cumulus congestus and cumulonimbus capillatus with incus (anvil), Parkdale, Victoria
Photo by Ken Hayes

Main messages

Earth is warming and large step-changes in climate may occur.

Since the release of the *Fourth assessment report: climate change 2007* from the Intergovernmental Panel on Climate Change, observations and research outcomes have further confirmed and strengthened the position that Earth is warming and that human emissions of greenhouse gases are the primary cause. Internationally, there is a clear consensus among atmospheric scientists that mean global temperatures have risen compared with pre-industrial levels in 1750. In addition, a number of feedback mechanisms exist that can amplify or accelerate climate change and have the potential to cause large step-changes (sudden or major changes) in regional and global climate.

It is likely that we are already seeing the effects of climate change in Australia.

Although Australia's climate is naturally highly variable, evidence continues to accumulate that temperatures are increasing and rainfall distribution patterns are changing. Models project that, by 2030, average annual temperatures across Australia are likely to warm by 1 °C (above 1990 temperatures). Drying is likely in southern areas of Australia. As the driest inhabitable continent, Australia is recognised as particularly vulnerable to climate change.

We will need both a national approach and approaches at the state and territory level to mitigate and adapt to climate change.

There is broad international consensus that major reductions in greenhouse gas emissions are necessary to minimise the extent of climate change. Per person, Australia's emissions are the largest of any country in the Organisation for Economic Co-operation and Development (OECD). The *Fifth national communication on climate change* sets out the Australian Government's strategic approach to climate change. Such an overarching strategy, implemented at all levels of government via a range of policies, plans and programs, is essential if we are to succeed in limiting climate change and addressing key areas of vulnerability through adaptation. Early action to reduce emissions and to deploy targeted adaptation strategies will be less costly than delayed action.

Ambient air quality in Australia's major urban centres is generally good.

National health-based standards are rarely exceeded for prolonged periods, and very high levels of pollution are usually associated with short-lived extreme events such as bushfires and dust storms. Levels of carbon monoxide, nitrogen dioxide, sulfur dioxide and lead in urban air have decreased over the past two decades, but ozone and particle levels have not declined. Prospects for reducing levels of these two pollutants will depend on factors such as improved vehicle technology, the extent of ongoing low-density suburban development, the availability of reliable public transport and the impact of climate change.

Despite this broadly favourable situation, the impact of urban air quality on health is still of serious concern.

There is clear evidence that periods of poor urban air quality impact adversely on human health. One source estimates that urban air pollution accounts for 1% of deaths and illness in Australia, with some 3000 deaths attributable to this cause in 2003—nearly twice the national road toll. Research indicates there is no threshold below which key pollutants such as particles, ozone and sulfur dioxide have no health effect. This means that sensitive individuals, such as asthmatics and people with respiratory or cardiovascular disease, may be affected even when air quality standards are met.

Despite the success of the Montreal Protocol in controlling ozone depleting substances (ODSs), depletion of stratospheric ozone will continue for some decades.

Concentrations of chlorofluorocarbons and other ODSs in the atmosphere have been decreasing since the mid-1990s, but many of these substances are long lived and will continue to affect stratospheric ozone for some decades. Nevertheless, the prospects for recovery of the stratospheric ozone layer by around mid-century continue to be good.

Climate

State and trends

Over the relatively short span of 250 years, and for the first time in human history, we have changed and are continuing to change the composition of the atmosphere on a global scale. Levels of carbon dioxide, the most important greenhouse gas (GHG), have increased by around 39% above pre-industrial levels, principally due to burning fossil fuels. This has led to a clearly defined trend of increasing average global temperatures, and there is growing evidence of consequent changes in the complex interlinked atmospheric, oceanic and terrestrial processes that shape climate at global, continental and regional scales.

From 1970 to 2010, Australia's mean daily temperature rose in almost all parts of the country. Although total annual rainfall declined over much of eastern Australia and south-west Western Australia, increases were observed in central and northern Western Australia and in the north-west Northern Territory. The 13-year period from April 1997 to March 2010 was characterised by severe rainfall deficiencies that covered much of south-western and south-eastern Australia and south-eastern Queensland. For many places, the severity and duration of drought were unprecedented, with profound environmental, social and economic implications. Then, in the 12 months from March 2010, large parts of the continent experienced above-average rainfall associated with an extremely strong La Niña event. Most notably, eastern Australia received widespread record-breaking rains, with associated loss of life and massive damage to agriculture, homes and infrastructure.

The summer of 2010–11 will be remembered as one of extremes, with Perth experiencing a record run of temperatures above 30 °C. By contrast, when averaged across the continent, summer maximum temperatures were 0.72 °C below the norm, making them the lowest since 2001. Despite this, the decade ending in 2010 was the hottest 10-year period on record for Australia, with the average land surface temperature 0.52 °C above the 30-year average from 1961 to 1990.

Pressures

The energy balance of Earth's atmosphere is influenced by the presence of trace levels of GHGs, such as carbon dioxide, methane, nitrous oxide and water vapour (a major GHG), and natural and industrial aerosols. Since the start of the industrial era (around 1750), human activity (principally the burning of fossil fuels) has caused significant increases in the concentrations of these GHGs. Measurements at global background monitoring stations show GHG concentrations continuing to increase in line with long-term trends and future projections. Per person, Australia's GHG emissions are the largest of any OECD country (26.8 tonnes in 2008—nearly twice the OECD average), reflecting Australia's heavy reliance on fossil fuels for our primary energy.

Effectiveness of management

If Australia is to achieve the national 2020 target of a 5% reduction in GHG emissions below 2000 levels, the range and effectiveness of abatement measures will need to be greatly increased. This is the key aim of Securing a Clean Energy Future, the Australian Government's climate change plan released in July 2011, which sets out details of a mechanism to establish a price on carbon and drive reductions in emissions via least-cost means. The plan aims to achieve Australia's unconditional emissions reduction target—a reduction of 5% on 2000 levels by 2020. This will require abatement of at least 23% of GHG emissions by 2020. To achieve Australia's 15% conditional target, a 31% reduction would be needed. The plan builds on existing measures, such as the legislated 20% Renewable Energy Target and the Carbon Farming Initiative, to promote development of renewable energy sources, energy efficiency and action to sequester carbon.

However, even if national and international mitigation efforts were to increase dramatically over the next decade or two and emissions were stabilised, temperatures will remain at elevated levels for centuries to come, making adaptation to change essential.

The issue of climate change is one that we ignore at our own peril. … And unless we free ourselves from a dependence on these fossil fuels and chart a new course on energy … we are condemning future generations to global catastrophe.

Barack Obama, *Energy independence and the safety of our planet*, 3 April 2006

Current governance is complex, because three tiers of government need to work with the private sector and the community to plan for and implement effective mitigation and adaptation measures. Coordination of federal and state programs has improved via actions by the Council of Australian Governments (COAG). Understanding of the science of climate change as it relates to Australia is continuing to improve, as is confidence in modelling projections at both national and regional scales. There is extensive support for policy and priority setting at a national level through the initial Garnaut Climate Change Review (2008) and subsequent review update (2011) and through an improved national GHG emissions reporting system. The Australian Government has established a broad ('three-pillars') strategy, underpinned by the Renewable Energy Target, an energy efficiency strategy and a national adaptation framework that was adopted by COAG in 2007. The Australian Government has committed around $15 billion to climate change initiatives. States and territories are also applying significant resources to mitigation and adaptation programs.

Outlook

The latest *State of the climate* report notes that, by 2070, if growth in global emissions of GHGs continues in line with past trends, Australia will warm by 2.2–5.0 °C. A rise of around 2 °C over just two centuries is expected to lead to widespread and significant risks to Australian natural ecosystems, water security and coastal communities. The prospects of an international agreement on a framework to stabilise global emissions at either 450 parts per million (with a likely rise of 2 °C in global average temperature) or 550 parts per million (with a likely rise of 3 °C) appear to be limited. Many climate scientists feel that a 2 °C increase is near to or above the level that is likely to trigger 'dangerous climate change'.

For Australia, with a climate characterised by high variability, climate change poses a clear and present threat. Although projections of Australia's future climate at national and regional scales are still uncertain, the most recent comprehensive review

Thunderstorm, Fogg Dam Conservation Reserve, Northern Territory
Photo by Jacci Ingham

of modelling outcomes shows that a continuing, spatially variable rise in temperatures across the continent is highly likely. Projections of rainfall are more variable, but half of the 23 models considered by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology show an increase in annual and summer rainfall in northern Australia, while nearly all show a decrease in winter rainfall in the south-west and along the south coast. A further risk associated with climate change is the likelihood of more frequent and more severe extreme weather events, such as floods, droughts and heatwaves. These primary atmospheric risks in turn generate a broad series of secondary and tertiary risks, including increased mortality and morbidity due to heatwaves and spread of disease vectors; reduced stream flows and groundwater recharge; reduced soil moisture and loss of topsoil; and changes in habitat with attendant risk to biodiversity. An increase in bushfires is also likely.

Australia, with its highly developed economy and physical, human and social capital, is better placed than many nations to anticipate the threats and opportunities associated with climate change and to take adaptive action in the short to medium term. However, this is no reason for complacency or for delaying urgent action, particularly given the potential for feedback mechanisms to amplify or accelerate climate change and cause large step-changes in regional and global climate. Should such changes occur, adaptive strategies framed around incremental change are unlikely to be adequate to prevent major harmful impacts on key sectors. Instead, what CSIRO describes as 'transformational' change will be needed and 'a major scientific and societal challenge [will be] to understand and decide how, where, and when this transformational change is required'.

Ambient air quality and other atmospheric issues

State and trends

Depletion of the stratospheric ozone layer, particularly in the form of the seasonal 'ozone hole' over Antarctica, remains of concern because the ozone layer limits the amount of harmful ultraviolet light reaching the lower layers of the atmosphere. Since peaking in the mid-1990s, levels of stratospheric chlorine and bromine from chlorofluorocarbons and other ODSs have decreased and are continuing to decrease. This drop is expected to continue with the ongoing phase-out of ODSs under the Montreal Protocol on Substances that Deplete the Ozone Layer.

Ambient air quality in Australia's major urban centres is generally good. National health-based standards are rarely exceeded for prolonged periods, and very high levels of pollution are usually associated with short-lived extreme events, such as bushfires and dust storms, that generate very high levels of particulate pollution. Levels of carbon monoxide, nitrogen dioxide, sulfur dioxide and lead have declined in urban areas over the past two decades.

However, air quality in our major cities still impacts on human health. Levels of particles and of the secondary pollutant, ozone, have not decreased. Both these pollutants affect cardiovascular and respiratory health and can lead to illness and death. Research into the health effects of particles and ozone, as well as pollutants such as sulfur dioxide, indicates that there is no threshold level below which they have no health effect. This means that sensitive individuals—such as asthmatics and people with respiratory or cardiovascular disease—may be affected even when air quality standards are met.

Most Australians spend more than 90% of their time indoors, leading to concern over the possible impacts of indoor air quality on our health. Symptoms associated with poor indoor air quality can range from mild and generally nonspecific (eye, nose and throat irritation, and headaches and dizziness) to severe (asthma, allergic responses and increased cancer risk). Despite the potentially significant health effects of indoor air, data on indoor air quality in Australia are limited, and Australia has no specific guidelines for indoor air quality to inform assessments of overall status and trend.

Partial solar eclipse through a thick plume of bushfire smoke, Broken Bay, New South Wales
Photo by Manfred Gottschalk

Pressures

GHGs (notably carbon dioxide, methane and nitrous oxide) that are not controlled under the Montreal Protocol are expected to significantly affect future stratospheric ozone levels. Nitrous oxide is produced by a variety of natural and human-related sources (notably agricultural processes). Although its ozone depleting potential is low relative to chlorofluorocarbon-11, human emissions are at such a large scale that it is recognised as the single most important form of ozone depleting emission, and is expected to remain so throughout this century. Emissions of nitrous oxide could (in the absence of effective abatement strategies) slow the rate of recovery of stratospheric ozone levels.

The air quality in Australia's major cities is no longer principally influenced by emissions from industrial point sources. With the exception of a few centres dominated by large industrial facilities (such as Mount Isa and Port Pirie), widely spread, diffuse emissions now constitute the major source of pollutants in urban areas. Among these, motor vehicles are the single most important source, contributing carbon monoxide, particles, various toxic volatile organic compounds (VOCs) and nitrogen oxides (which, together with VOCs, act as precursors to the formation of ozone). In addition, diesel vehicles are an important source of particles.

All things share the same breath—the beast, the tree, the man ... the air shares its spirit with all the life it supports.

Attributed to Chief Seattle, 1854

Commercial premises are another important diffuse source of pollutants (VOCs and particles). In urban centres where wood heaters are widely used, domestic premises are an important diffuse source of particulate pollution during winter. Planned burning for agriculture, forestry operations and land management can also be a source of diffuse pollution. If not well planned, timed and executed, such burns can trigger health problems and loss of amenity in surrounding areas.

The quality of indoor air is affected by many factors, including building materials (volatile materials like glues and paints), ventilation, furnishings, use of appliances (cooktops, ovens and unflued gas appliances), environmental tobacco smoke and cleaning agents. Rising domestic heating and cooling costs are likely to promote better sealing of dwellings to reduce loss of heated and cooled air. This can be expected to lead to reduced air exchange and a deterioration in indoor air quality.

Effectiveness of management

The Montreal Protocol is one of the world's most effective international environment protection agreements, orchestrating the phase-out of a broad range of ODSs. Australia has ratified the protocol and, as a signatory, all subsequent amendments and has reduced its use of controlled substances well ahead of its international obligations.

For more than a decade, Australia has had national standards and goals for ambient air quality—the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM)—based on strong empirical evidence about the health impacts of major pollutants. The AAQ NEPM is supported by national emission standards for new vehicles, set in the Australian Design Rules, and by fuel quality standards, both of which are established through Australian Government legislation. Although the size of the Australian vehicle fleet is continuing to grow (as are the distances travelled), emissions are expected to continue to decline over the next decade as a result of tighter national fuel standards and the mandating of improved emission-control technologies.

During the past 30–40 years, state and territory environment protection agencies have employed a variety of regulatory measures (including works approval, licensing and notices) to control and greatly restrict emissions of air pollutants from industrial and commercial sources. More recently, nonregulatory measures (such as codes of practice, market-based mechanisms and cleaner production incentive schemes) have been increasingly used to complement regulatory controls.

Australian governments have also actively sought to improve indoor air quality through a range of interventions (both regulatory and nonregulatory) targeting environmental tobacco smoke and unflued gas heaters. All states and territories prohibit smoking in cinemas and theatres, in most types of public transport and in areas where food is prepared and consumed. Increasingly, similar bans are being applied to various outdoor public spaces. Unflued gas heaters all require compliance with Australian standards. However, as various studies have shown, conformity with the Australian standards does not guarantee that emissions will not adversely affect health.

Outlook

As a result of the success of the Montreal Protocol in controlling ODSs, the stratospheric ozone layer is expect to recover to 1980 benchmark levels by around mid-century.

The outlook for Australia's urban air quality is generally good. However, there is clear evidence that periods of poor urban air quality have serious adverse impacts on human health. Although levels of carbon monoxide, lead, nitrogen dioxide and sulfur dioxide have decreased over the past 10 years, ozone and particle levels have not declined, and ongoing effort will be required to secure past gains and achieve further improvements. Prospects for reducing levels of ozone and particles will be influenced by a number of factors, most notably vehicle technology, the extent of ongoing urban sprawl, the availability of reliable public transport and the impact of climate change.

Climate change is likely to affect air quality in a variety of ways. Rising temperatures are likely to lead to the formation of more ground-level ozone by increasing the generation of both natural and human-generated VOCs. Hotter, drier conditions in many parts of the country, together with more extreme weather events (another likely result of climate change) can be expected to increase bushfires and dust storms, leading to short-lived, very high levels of particulate pollution.

Inland water

Junction Waterhole, Haasts Bluff, Northern Territory
Photo by Ken Duncan

Main messages

Pressures of past human activities and recent droughts are affecting our inland water systems.

Most of the ongoing impacts on Australia's inland water environments are legacies of our historical land use, pest and weed introductions, and water resource development. In northern and remote Australia, human impacts have not significantly affected ecosystem function; in most southern regions, inland water ecological processes have changed substantially since European settlement and ecosystem function is significantly affected. The populations of many native species have declined. During the past decade (longer in some areas), the southern half of the continent experienced a drought of unprecedented duration and extent, which dramatically changed inland water environments, and there is evidence that this partly reflects a changing climate.

Climate change poses our greatest future threat.

The main risk to inland water environmental health that remains poorly mitigated is the likelihood of a drying and warming climate in our southern catchments and warmer temperatures across Australia. Current water-sharing rules tend to favour water entitlement holders over environmental flows in dry times. This means water is allocated for human use in preference to allowing water to stay in inland water systems. Managing for extreme conditions is emerging as a vital issue as the implications of a changing climate become more certain.

Meeting our water needs will be a critical challenge.

Demands for water will increase as Australia's population grows, and withdrawing water changes our inland water ecosystems. However, increased demand could be met without taking much more fresh water out of the environment (but potentially with other environmental costs, including increased energy use associated with desalination or wastewater recycling). Reduced water use will also play a part—Australia's water consumption fell 25% from 2004–05 to 2008–09.

Withdrawing water for other uses changes our inland water ecosystems.

Almost every inland ecological system in Australia is either permanently or seasonally limited by a shortage of water. Permanently withdrawing (abstracting) water from these systems will inevitably change their character in some way and degree. Conversely, this same water-limited ecology and our highly variable climate make these systems relatively resilient to small or short-term reductions in water availability.

The past decade has been Australia's most ambitious period of water policy reform.

All states and territories have now committed to the principles of the National Water Initiative. This commitment includes providing secure water for sustaining the environment. In addition, establishing an efficient and effective water market model will mean that prices will reflect the scarcity of water in Australia and water should flow to the economic, social and environmental uses of highest value.

Remediation of catchment water quality is not yet well managed.

While water abstraction pressures on inland water environments are becoming better managed (and, in places, alleviated), there is less monitoring, coordination and effort applied to the remediation of catchment water quality. Planning and management of these two dimensions of catchment health are still largely separate and could be coordinated and improved.

Better understanding is needed about how well ecosystems can withstand changes in water regime.

Except for the south-west corner of the continent, the southern drought ended in late 2010 with widespread flooding. Monitoring of river and wetland ecosystem recovery following these floods will provide crucial insights into how inherently resilient these systems are.

Inland water

State and trends

Many of Australia's inland water environments are in a degraded condition. In southern Australia, and particularly the Murray–Darling Basin, this is the result of relatively high levels of water resource development, compounded by an extended drought. During the past decade (longer in some areas), the southern half of the continent experienced a drought of unprecedented duration and extent. This dramatically changed the character of inland water environments.

Except for the south-west corner of the continent, this drought ended in late 2010 with widespread flooding. The recovery of river and wetland ecosystems following these floods will provide crucial insights into how inherently resilient these systems are—if this recovery is appropriately monitored.

In south-western Australia, the current drought has led to a decline in river and wetland health as a result of low flows and high stream salinities (from lack of dilution). Northern Australian and Tasmanian inland water environments are generally in good condition.

Nutrient levels in guidelines for fresh water are exceeded in all metropolitan areas and most areas of intensive agriculture. Monitoring of water quality, and interpretation of trends and causes, are inconsistent and sparse. It is therefore not possible to identify improving trends resulting from improved land practices.

Ecological processes have been altered to some degree across most parts of the continent. For much of northern and remote Australia, these changes are not significantly affecting ecosystem function and, with a few exceptions, there is little evidence that populations of aquatic species are declining. In most southern regions, inland water ecological processes have changed substantially since European settlement, significantly affecting ecosystems and causing declines in many native species populations.

Pressures

Much of the pressure on our inland water environment is a legacy of the past—the clearing of native vegetation in catchments, the intentional or accidental introduction of weeds and pests, and the drainage of wetlands. These have moderate, ongoing consequences at the national scale.

Extensive land clearing has greatly decreased over the past 30 years, but urban expansion continues to affect wetlands and streams on the urban fringe, resulting in increased diffuse pollution and loss of habitat. Progress has been made towards controlling some of the serious weeds affecting inland water environments. The westward spread of cane toads across northern Australia is affecting systems in this region, and introduced fish species continue to have heavy impacts on aquatic ecosystems.

Although there is only limited capacity to reverse many historic impacts, there is reason to believe that projected population and economic growth can be significantly decoupled from future pressures on our inland water ecosystems. Australians are using less water, and while our rising population will increase demands for urban water, this is likely to be met without taking proportionately more fresh water out of the environment.

Progress towards restoring some environmental flows and plans by metropolitan water utilities to reduce future additional demands on freshwater resources are positive changes with respect to the pressures from water abstraction from the natural environment. The breaking of the extended drought in south-eastern Australia has provided much-needed flows. Nevertheless, the long-term environmental health of many southern Australian systems remains compromised by the amount of water abstracted for use. Surface water and groundwater overuse, with major consequences for local inland water environments, is likely to continue in many areas of southern Australia until the principles of the National Water Initiative are fully implemented and adjustments to abstraction levels are made. Systems in northern Australia generally have a low level of environmental pressure due to water abstraction.

We never know the worth of water till the well is dry.

Thomas Fuller,
Gnomologia, 1732

There is compelling evidence that the ongoing drought (since 1975) in south-west Western Australia is partly related to human-induced climate change. It is almost certain that Australia's climate is continuing to change and that this will, if unmitigated, change water balances, flow regimes and inundation patterns of floodplains and wetlands. This is of great concern, because the implications will be major and widespread if the risk is not managed.

Effectiveness of management

Using water from our environment is fundamental to our sustainability as a society. We have had an ambitious decade of water policy reform with all states and territories committing to the principles of the National Water Initiative. This initiative is designed around a market, regulatory and planning-based system to manage surface water and groundwater resources for rural and urban use in a way that optimises economic, social and environmental outcomes. This commitment includes provisions of adequate water for sustaining the environment.

Our understanding of the pressures on inland water ecosystems is good, and tends to be reflected in planning. Planning of water supply to take into account environmental needs and climate change is excellent for metropolitan areas, which are increasingly taking the approach of 'water security through diversity'. Examples are emerging of significant local or regional improvements in environmental flows or water quality.

However, strong empirical science on the quantitative relationship between flow regimes and ecosystem response or health is widely lacking, and this is hampering planning. Planning is incomplete for many water resource areas and uneven for water quality recovery. Significant investments are being made in recovering water for environmental flows, but the investment in improving water quality is small relative to the size of the challenge.

McCreadies Billabong, Litchfield National Park, Northern Territory
Photo by Nick Rains

Processes for planning and management generally fail to meet expectations for consultation to allow Indigenous input, as agreed under the National Water Initiative. Public reactions to the *Guide to the proposed Basin Plan* for the Murray–Darling Basin highlighted the need for additional consultation.

Outlook

Although the capacity to reverse many historical impacts is limited, there is reason to believe that projected population and economic growth can be significantly decoupled from future pressures on our inland water ecosystems. Mitigating the risks to inland water ecosystems arising from a changing climate will be far more challenging and may not be entirely possible. With some additional management intervention and investment, the inland water environment is likely to remain in generally good condition in northern Australia and in poor, but potentially improving, condition across much of the south, with only limited regions showing continuing serious deterioration. Much of the potential for improvement relies on adjusting future levels of water abstraction to meet environmental flow requirements, in a future that is likely to be drier in the south due to climate change.

Land

Newman, Western Australia
Photo by Christian Fletcher

Main messages

We use land in various ways, and land use is changing in response to new priorities and new pressures.

We use our land for livestock grazing, agriculture, forestry, urban and residential development, mining, waste disposal and infrastructure. Livestock grazing is the land use of greatest extent, accounting for 55% of Australia's land area. The areas managed for conservation and by Indigenous Australians have expanded and are the second most common land uses (each now more than 20% of Australia's land area).

Australia's land environment is threatened by widespread pressures.

Invasive species, inappropriate fire patterns and grazing have a significant impact on much of our land environment. The environmental impact of grazing appears to be mixed, with impacts diminished in some regions but increased in others since widespread monitoring began in 1992.

Threats to our soil, including acidification, erosion and the loss of soil carbon, will increasingly affect Australia's agriculture unless carefully managed.

Acidification and erosion currently affect large areas, although wind erosion has decreased in response to better agricultural practices. In 2001, it was estimated that soil acidity affected 50 million hectares of surface layers and 23 million hectares of subsoil layers, estimated to cost $1.585 billion per year in lost agricultural production. Soil carbon is central to maintaining soil health and fertility, and soil can also be a significant source or sink for greenhouse gases, depending on land management. Soil carbon stocks are low in many Australian agricultural systems.

Management effectiveness of the land environment varies.

The effectiveness of our management of the land environment varies with land use and the nature of the pressures on the environment. The nature of widespread, landscape-scale pressures and resource constraints often makes it difficult to manage more extensive land uses and pressures as effectively as we would wish. A notable exception during the past decade is the large and widespread reduction in tillage intensity across the cropping lands of Australia.

The rate of land clearing, one of the most significant pressures affecting the land environment, is slowing, but still averaged around one million hectares each year over the decade to 2010.

Land clearing and ecosystem fragmentation are associated with the expansion of both agriculture and settlements, and are concentrated in a relatively small number of regions. The legacy impacts of land clearing are substantial, with loss and fragmentation of native vegetation. By the end of the decade, the continental extent of land clearing was balanced by the extent of regrowth—although the character and values of the original and regrowth vegetation are often different.

Governance and institutional arrangements for management of the land environment need improvement, and levels of investment are inadequate.

Governance and institutional arrangements have changed significantly since 2006, and are not yet optimal in a number of important respects. Although substantial, the levels of investment in management of the land environment—and in the research, development, knowledge and information systems that underpin management—remain inadequate for soundly based adaptive management.

Climate change is expected to bring about profound changes in the Australian land environment, particularly native vegetation and production systems.

Some native vegetation communities are likely to disappear completely; the extent and distribution of others are likely to change significantly; and novel ecosystems are expected to arise. These changes will affect other environmental and production values.

Land

State and trends

We have made progress in many aspects of managing Australia's land environment. However, the trends for many indicators of land environmental values remain adverse. Although soils and vegetation are in relatively good condition across large areas of Australia, this is not the case in much of the intensive land-use zone where agricultural production is concentrated, nor in some parts of the rangelands.

While land-management practices have improved during the past few decades, in agricultural systems the loss of soil carbon, and soil acidification and erosion, are problematic and may have major impacts on production.

The management and monitoring of soil carbon is a matter of national and international importance. The carbon content of soil is a key indicator of its health, and is a master variable that controls many processes (e.g. nutrient cycling, development of soil structure, water storage). Few regions have increasing levels of soil carbon, although the potential in the savanna landscapes of northern Australia is significant. Depending on how soils are managed, they can be a significant source or sink for greenhouse gases.

Soil acidification affects about half of Australia's agriculturally productive soils. Its severity and extent are increasing, and large areas will become unproductive and degraded. Soil acidification also looms as a major constraint on Australia's capacity to increase carbon in agricultural soils.

The widespread adoption of minimum tillage in agriculture during the past decade is a major achievement by Australian farmers that reduces pressures affecting the land environment. However, current rates of soil erosion by water across much of Australia exceed soil formation rates by a factor of at least several hundred and, in some areas, several thousand. The latter areas will be severely degraded in less than a century. However, the rate of wind erosion during the recent drought in southern Australia was less than 20% of that during the 'dust bowl years' of the 1940s.

The longer settled agricultural and coastal zones have the highest concentration of impacts on native vegetation. In most of these regions, less than 50% of native vegetation remains, and vegetation condition generally deteriorates with diminishing remnant extent. Approximately 13% of native vegetation nationally has been completely converted to other uses.

Annual rates of native vegetation clearing averaged around one million hectares in the decade to 2010, balanced by the extent of regrowth by the end of the decade. The condition of much native vegetation is deteriorating, particularly that remaining as fragmented remnants in intensive and settled land-use zones, and that subjected to persistent pressures such as inappropriate grazing or fire regimes. Land clearing and ecosystem fragmentation associated with the expansion of both agriculture and settlements are concentrated in a relatively small number of regions.

Pressures

The impacts of climate change on the land environment are already being seen, and are expected to be profound. By 2070, many environments will differ markedly from those that currently exist. Some vegetation communities will disappear, others will change significantly in extent and distribution, and novel ecosystems will arise. Many agricultural and production systems, including forestry, are likely to be significantly adversely affected.

Widespread landscape-scale pressures—particularly those due to invasive species and inappropriate fire regimes—continue to threaten land environmental values across much of Australia. These pressures are likely to be exacerbated by climate change. The impacts of these pressures are particularly pronounced on the extensively managed environments of northern Australia.

Livestock grazing is the most extensive of Australia's land uses, practised across 55% of the continent. Pressures on the land environment associated with livestock grazing are mixed; they appear to be diminishing in some regions, but increasing in others. Although better management of many agricultural systems has reduced their impacts on the land

Land is life.

Richard Baker, *Land is life: from bush to town—the story of the Yanyuwa people*, 1999

environment, a number of issues around nutrient and soil management remain. Acidification and loss of soil carbon are major risks to our agricultural production systems. Management of both native and plantation production forests has become more regulated, and landscape-scale impacts are generally small.

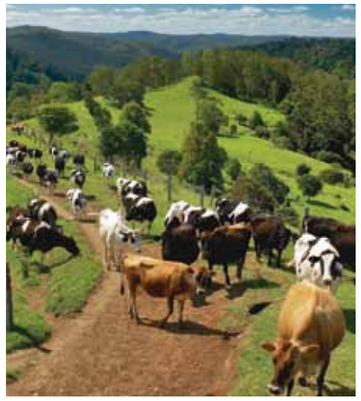
Urban and peri-urban expansion, particularly around major cities and in some coastal regions, continues to adversely impact land environmental values. New forms of mining are generating pressures on the land environment, and conflicting with other land uses, notably agriculture, in some regions.

Effectiveness of management

Most of Australia's land environment is managed by one of three groups: state and territory agencies responsible for public land of various tenures, family and corporate agricultural and pastoral businesses, and Indigenous Australians.

The effectiveness of our management of the land environment varies with land use and the nature of the pressures on the land environment. The effectiveness of management has improved for most land uses, particularly those that are most intensive, but needs to improve further in many land-use systems to protect and sustain their environmental values. Because of the nature of widespread landscape-scale pressures and resource constraints, it is often difficult to manage more extensive land uses and pressures as effectively as we would wish. As a consequence, management outcomes for many forms of land use and in response to many pressures are trending downward.

Although substantial, investment remains inadequate in management of the land environment, and in the research and development programs and knowledge and information systems that underpin good land management. Australia's investments in natural resource management appear to be less on a per-hectare basis (of agricultural land) than in Europe or the United States, and are generally regarded as inadequate to meet Australia's environmental management needs.



Dairy cows, Queensland
Photo by John Dick

There is also a serious gap in both the professional and the technical capacity necessary for effective land management. This gap will increase and its consequences become more acute as we face the challenges that climate change will bring to land environmental values and production systems.

Outlook

The outlook for Australia's land environment is mixed. It depends on the conjunction of past, current and future pressures, and how we manage them.

Future land environments are likely to be shaped by a different climate from that experienced in Australia's human history. This is expected to have profound impacts on our land environment. Australia's land environment will also be subject to increasing land-use competition, including between human settlements; conservation; and food, fibre and energy production.

We have much of the knowledge and experience required to better manage our land environment, and have been doing so in many respects. However, the trends in many indicators of land environmental values are negative, and are likely to be exacerbated by climate change. Realising a more positive outlook for Australia's land environment will require renewed resolve, effort and investment.

Marine environment

Acropora coral reef, Great Barrier Reef, Queensland
Photo by Gary Bell

Main messages

The overall condition of the Australian marine environment is good.

Compared with the marine waters of other nations, Australia's oceans are considered to be in good condition. This is a testament to the limited pressures of the past century, combined with relatively good management of high-priority and emerging issues in recent years.

Areas near the coast are suffering.

Despite the overall good condition, there is substantial degradation in the east, south-east and south-west. Ecosystems near the coast, bays and estuaries in these regions are in poor to very poor condition. Much of the impact occurred in the mid-19th and 20th centuries, and recent impacts principally arise from unregulated human activities in river catchments, urban and coastal developments, and fishing. Aquaculture in coastal waters has resulted in major disease outbreaks that have affected the ecology of native species. Oyster reefs, which formerly occurred in many estuaries across the south-east region, were mined for lime in the 1800s and are now functionally extinct.

There are significant existing impacts on the oceans caused by human activities.

Fishing and offshore developments, particularly oil and gas extraction, all have local impacts on marine biodiversity, although the pattern of impact is different between the north and the south, and between the east and the west, aligned with the distribution and intensity of the pressures.

The ocean climate is changing and we need to prepare to adapt.

There are likely to be major impacts in the coming decades from rising sea levels, increased incidence and severity of extreme weather events, altered ocean currents, changing patterns of biodiversity, and changing productivity. Although there are currently only limited signs of changes in ecosystems, these will develop further and have important consequences for our coastal communities, wildlife and fishing. In particular, ocean acidification will have a major impact on marine ecosystems, since it can affect the base of marine food webs by diminishing the ability of planktonic organisms, which are food for many other organisms, to form shells.

An extended continental shelf has been granted.

Under the provisions of the United Nations Convention on the Law of the Sea, in 2008 Australia was granted a large (23%) increase in the seabed territory it controls. This is now 13.86 million square kilometres—the third largest national marine territory in the world's oceans.

Our understanding of major aspects of our unique marine biodiversity is limited.

Our knowledge of seabed geology and topography, oceanographic systems and physical processes has increased, but our knowledge of biodiversity and ecological processes remains limited. Ongoing research programs in marine biodiversity and ecological function are a high priority and, because our existing knowledge is dominated by information about fished species, it is particularly important to increase our understanding of non-exploited species and their roles in maintaining healthy and resilient ocean ecosystems.

The lack of a nationally integrated approach inhibits effective marine management.

The cumulative pressures on our marine ecosystems are rapidly growing. Present-day management systems lack integration among the various federal, state and local government systems that provide for planning, regulation and management of the marine and estuarine waters. This significantly impedes the design and delivery of effective policies and programs to maintain healthy and productive marine ecosystems and oceans. An integrated national system of multilevel governance for conservation and management would enable the natural wealth of our oceans to be maintained in the face of challenges, and would reward us with healthier oceans and increasing economic returns.

Marine environment

State and trends

Australia's oceans and coastal marine ecosystems are overall in good condition and have experienced only gradual decline, although there are many coastal areas where conditions are already poor or very poor. Indeed, some of the world's worst examples of impacts from pollution can be found in Australian waters.

While the overall health of our marine ecosystems is assessed as good, this finding is influenced by the good condition of the offshore waters and the remote coastlines of regions where pressures are lowest. In inshore waters near the coast of the south-west, east and south-east regions, and near urban areas and industrial developments, ecosystems are in poor health. Algal blooms occur regularly; natural levels of freshwater, sediment and nutrient inputs have been heavily altered; and worrying levels of pesticides are found in waters near areas of intensive agriculture. The ecosystem health of some nearshore marine waters and many estuaries is poor, particularly across the temperate areas and in many parts of the south-east region. The south-east region is assessed to be in the worst condition: most places are good, but the worst 10% of the region is poor—existing values are significantly impacted, and serious further degradation is expected within 50 years.

Marine biodiversity overall is in good condition, but nationally there are a number of areas on the coast, continental shelf and upper slope where the condition of some elements of biodiversity is very poor, as a result of the effects of human activities. Condition remains poor to very poor for a number of iconic species that have failed to recover from earlier impacts of excessive hunting and fishing, and some species continue to decline. These include Australian sea lions, which are unique to temperate southern Australian waters and are showing no substantial signs of population recovery from the hunting of previous centuries; and migratory wading birds, which appear to be continuing to decline across many of their Australian habitats. Southern bluefin tuna, formerly a major predator of our regional seas, has been fished to the edge of population survival but is now listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999*; its global catch has been reduced and a management procedure has been proposed to rebuild the population. In addition to national-scale biodiversity problems, there are many more habitat and species issues in smaller local areas.

Pressures

The Australian marine environment is experiencing a broad range of pressures that affect the quality of habitats, species and environmental health. The main pressures are in coastal areas, particularly in sheltered enclosed bays, estuaries and lagoons, where removal of land-based sources of pollution and wastes by flushing is most limited. These pressures and their impacts primarily affect the east, south-east and south-west regions; many parts of the north and north-west regions remain in near-pristine condition, although development pressures are rapidly increasing. This pattern reflects both the existing distribution of Australia's population and the distribution of the industries and activities that rely on coastal resources. However, the north-west is beginning to come under intense development pressures from the resource extraction sectors (oil and gas, mining, fishing, shipping). Only the marine values and assets of the north region remain relatively pristine, although even there, mining and river damming are growing pressures. The south-east region remains under the greatest stress, with a legacy of impacts from a wide variety of sources, and is suffering the greatest impacts from changing climate—the East Australian Current is changing its pattern of extension into Tasmanian waters, with an intensification of gyres (circular currents), and is becoming warmer and saltier.

Exploitation has overtaken waste disposal as the major source of impacts in Australia's oceans. A proliferation of oil and gas exploration and extraction, together with new energy and water systems and other shoreline industries, bring not only important initiatives in wealth generation, but also a major new set of risks to our waters that will require strategic and regional management. Nearshore development is proceeding quickly, replacing vegetated landscapes with hard surfaces that interrupt wetland functions and estuarine flows. Land-based sources of pollution and expanding pressure on coastal lands continue to

How inappropriate to call this planet Earth when it is quite clearly Ocean.

Arthur C Clarke, *Nature*, 8 July 1990

be a significant concern despite strong improvements in land-use planning and the management of many point sources of pollution. Fishing has reduced most populations of sought-after species to low levels, mainly in previous decades. The maintenance of these low population levels by present-day management policies probably has significant flow-on consequences for the resilience and persistence of marine biodiversity in all inshore waters.

The major looming threat for our oceans and coastal waterways is the changing global climate, which is creating significant changes in ecosystems, biodiversity, shorelines and coastal lands. The main impacts of climate change for the marine environment are increased temperature, ocean acidification and sea level changes. Climate change threatens our wealth generation from the oceans, and the existence of our coral reefs at their present-day scale and grandeur.

Effectiveness of management

Many improvements in management systems at both state and national levels have produced substantial and persistent outcomes for marine ecosystems and biodiversity. These arise from programs devoting considerable resources to environmental protection and improvement of estuarine and coastal ecosystems across all jurisdictions.

Nonetheless, most of these efforts are poorly coordinated within jurisdictions and only weakly harmonised with a national approach, and there are no systematically derived regional objectives for marine biodiversity to guide strategic planning or management. Each region has a specific set of pressures that will almost certainly worsen over the coming 20–50 years, given current management arrangements. For example, in the north-west, while many habitats and species populations are in near-pristine condition, more impacts will occur with the escalation of the oil and gas industry. There is limited federal leadership in the implementation of an effective national system for management of coastal marine ecosystems and biodiversity, and their protection from persistent and emerging threats. There is continued loss of biodiversity, duplication of effort, inefficiencies, an overall lack of effectiveness, and distrust among the sectors, the various jurisdictions and the community. A vertically and horizontally integrated national system for marine conservation and management is widely seen as a critical gap in management.

Australian sea lions (*Neophoca cinerea*), Hopkins Island, South Australia
Photo by Michael Patrick O'Neill

Outlook

The overall outlook for Australia's marine environment is uncertain—most aspects are currently not in decline, and those that are declining have moderately well understood underlying pressures and drivers. Of those assets and values that are already in poor condition, very few are recovering.

The interaction of accelerating changes in the climate with existing land uses, fishing systems, shoreline industries and new risks is presenting ocean management with unprecedented challenges. There is a plethora of responses to this situation, many of which are achieving good outcomes; some are reducing pressures, and holding the ecosystems and biodiversity in good condition. However, the evidence shows that our management systems are still too fractured, weakly coordinated and poorly integrated to halt the accelerating degradation of the unique values of our oceans and coastal ecosystems. The early signals of such decline are now evident across a number of areas of our coastal waters.

We need our oceans and coastal ecosystems to continue to sustain and inspire Australia's future, as they have in our past. Perhaps the most critical challenge of all now confronts us—our ability to design and deliver effective and efficient governance to address the known threats and accelerating risks to our unique marine environment.

Antarctic environment

A lone Adélie penguin in front of a spectacular iceberg
Photo by Doug Thost

Main messages

The Antarctic environment is showing clear signs of climate change, which is likely to have profound effects on Antarctic species and ecosystems.

The East Antarctic Ice Sheet is losing ice at its coastal fringes—about 60 billion tonnes each year since 2006. The loss is occurring at an increasing rate and may contribute significantly to sea level rise. The upper layers of the Southern Ocean have warmed by 0.2 °C since the 1950s. This rate of warming is faster than elsewhere in the world.

The ozone hole has largely protected East Antarctica from global warming.

Over the past half-century, western Antarctic surface temperatures have shown general warming trends with significant regional patterns. The Antarctic Peninsula is warming faster than anywhere else on Earth. In East Antarctica, the lower stratosphere has cooled and changed the atmospheric circulation through the loss of stratospheric ozone. A recovery of the ozone hole will reverse these processes and significantly increase the warming trend in East Antarctica.

The terrestrial ecosystems are changing, especially where snow fall is replaced by rain.

Retreating glaciers (particularly in the subantarctic), higher ambient temperatures and precipitation as rain rather than snow make the terrestrial environment more accessible to plant and microbial communities. A warmer climate and increased availability of liquid water enables their populations to expand and non-native species to become established.

Antarctic vertebrates are highly specialised to survive in the Antarctic. Whether they can adapt to new conditions due to climate change is currently unknown.

Environmental changes cascade through ecosystems. In the Antarctic Peninsula region, an apparent decrease in the abundance of Antarctic krill has been attributed to the reduction in winter sea ice coverage. This in turn has caused a decrease in Adélie and chinstrap penguin populations. As the rate of environmental change increases, it may exceed the rate at which Antarctic vertebrates can adapt. Warmer waters also enable alien species to extend their range southward. Invading species are likely to outcompete, and perhaps replace, native species. It is likely that some native species will not survive the coming decades.

Increased acidification of the Southern Ocean can affect the base of Antarctic food webs.

Dissolved carbon dioxide acidifies the ocean and reduces the availability of carbonate ions that calcium carbonate shell-making organisms require for calcification, diminishing the ability of these organisms to form shells. Increasing ocean acidity due to increased levels of carbon dioxide is already affecting calcifying organisms—the shells of planktonic organisms known as foraminifera, which are food for many other organisms, are now about one-third lighter compared with pre-industrial times. These types of changes, which affect the base of the food web, can potentially change the dynamics of the Southern Ocean ecosystem significantly.

The pressure of human activities on Antarctica and the Southern Ocean is increasing.

The Protocol on Environmental Protection to the Antarctic Treaty commits signatories to comprehensive protection of the Antarctic environment. Australia has ratified the protocol by establishing legislation to enforce procedures that reduce the impacts of Australians visiting Antarctica and has taken practical steps to reduce the impacts of past activities, such as the clean-up of abandoned waste disposal sites. However, the human footprint in the region is gradually increasing. New stations are still being built; tourism to the continent continues to grow, particularly to the Antarctic Peninsula near South America; and, with a growing world population, commercial fishing activities are likely to increase.

Antarctic environment

State and trends

Antarctica is showing clear signs of climate change. The physical and chemical components of the Antarctic environment are changing at an increasing rate. The most rapidly changing region is West Antarctica, particularly around the Antarctic Peninsula, where temperatures have risen by 5 °C over the past five decades. Until recently, the environmental variables were thought to be more stable in East Antarctica. However, there is compelling evidence that change is occurring there as well, and while it is currently at a slower rate than in West Antarctica, the rate of change is expected to increase over the coming decades.

The complex Antarctic food web is based on vast numbers of marine microorganisms, including bacteria, phytoplankton and zooplankton. Changes to the marine environment, including ocean acidification, will have a significant impact on these organisms, and since they are at the base of the food web, these changes will have profound effects throughout Antarctic ecosystems.

Climate change and warming conditions are also supporting the movement of alien species into the region, where they may outcompete endemic species. For example, there is already evidence that king crabs are expanding their range and are moving south, where they will be a new predator for the local soft-shelled and no-shelled invertebrates. Many subantarctic islands already harbour alien plant species, which often thrive and outcompete endemic species. Many also carry the legacy of introduced vertebrates, such as rabbits or pigs that were released during the sealing years as food sources onto the islands. Rats and mice also abound and can cause havoc among seabird colonies.

Some populations of seals and penguins that were slaughtered in huge numbers in the late 19th and early 20th century have recovered while others, especially the seabirds, still suffer great losses in commercial fishing operations. Most whale species that visit the Southern Ocean are still on the Red List of Threatened Species of the International Union for Conservation of Nature.

Pressures

Antarctica, as the only continent without a native human population, has been subjected to less pressure from human activities than other continents. However, human presence on the continent still has an effect. Australia operates four permanently occupied Antarctic bases. About 4000 people work on the continent each year, and 53 650 people (including crew) visited Antarctica in 2010–11. Most human activities and environmental impacts are concentrated in the very limited ice-free areas, which impacts species that use these limited areas as important growth and breeding sites. The scale and intensity of human activities continues to increase, with new stations being constructed and tourism growing annually, particularly around the Antarctic Peninsula. Disturbance of habitat and wildlife, the introduction of invasive plants and pollution are all risks linked to human presence. Commercial fishing in the region places pressure on marine species, and the bycatch in illegal, unregulated and unreported fisheries is a significant threat. The extraction of marine resources will not only continue but will intensify in the future.

Human activities far away also have an effect on Antarctica. Pollution elsewhere on our planet finds its way even to Antarctica: traces of DDT and its derivatives were discovered in the shells of Adélie penguin eggs in the mid-1960s.

What is most likely to have the most lasting impact in the region is the increasing amount of carbon dioxide produced by human activities across the planet. The Southern Ocean is absorbing vast quantities of carbon dioxide, leading to a change in the ocean's chemistry that has the potential to affect organisms and their lifecycles in a variety of ways. Increased atmospheric carbon dioxide is also producing climate change in the region. The changes will affect the marine and terrestrial ecosystems of the region, probably profoundly, in the coming decades.

Extreme weather events are likely to increase in frequency and perhaps in intensity as the planet warms. Antarctica is known for its high winds and intense storms. However, in certain regions, rain is now occasionally falling where previously it would only snow. These events are also changing the Antarctic environment and may have a long-term effect on biodiversity.

We dwelt on the fringe of an unspanned continent, where the chill breath of a vast, polar wilderness, quickening to the rushing might of eternal blizzards, surged to the northern seas. … We had found the Home of the Blizzard.

Douglas Mawson, *The home of the blizzard*, 1930

There is still insufficient understanding about how various factors may interact. For example, recent research has discovered a link between the ozone hole and the rate of warming in East Antarctica. While the ozone hole exists, clouds forming as part of the processes that create the thinning of ozone appear to shield the continent from warming. Predictions are that a recovery of the ozone layer will significantly increase the rate of warming.

Effectiveness of management

Antarctic management is of international concern and is primarily regulated through the Antarctic Treaty and the Convention on the Conservation of Antarctic Marine Living Resources. Australia is committed to protecting Antarctica and adhering to all environmental protection measures through the Antarctic Treaty System, and leads efforts in the convention. Australia also plays a significant role in combating illegal, unregulated and unreported fishing in the Southern Ocean. Australia is developing ways to minimise the effects of our Antarctic activities; for example, by cleaning up historical waste tip sites, and developing procedures for remediation of oil spills and protocols to reduce the likelihood of accidental introduction of non-native species.

Research ensures that management of activities is based on sound scientific principles and the best available scientific knowledge. Australia's research in Antarctica and the Southern Ocean contributes to understanding how environmental systems function and how global climate change affects the Antarctic environment. While climate change cannot be mitigated through the management of activities in Antarctica, Australian research is helping to inform strategies to maximise the effectiveness of management of the Antarctic environment and ecosystems. It will also be important to understand the wider implications of Antarctic changes, as the atmospheric and oceanographic processes of Antarctica are important drivers for the weather in the Southern Hemisphere.

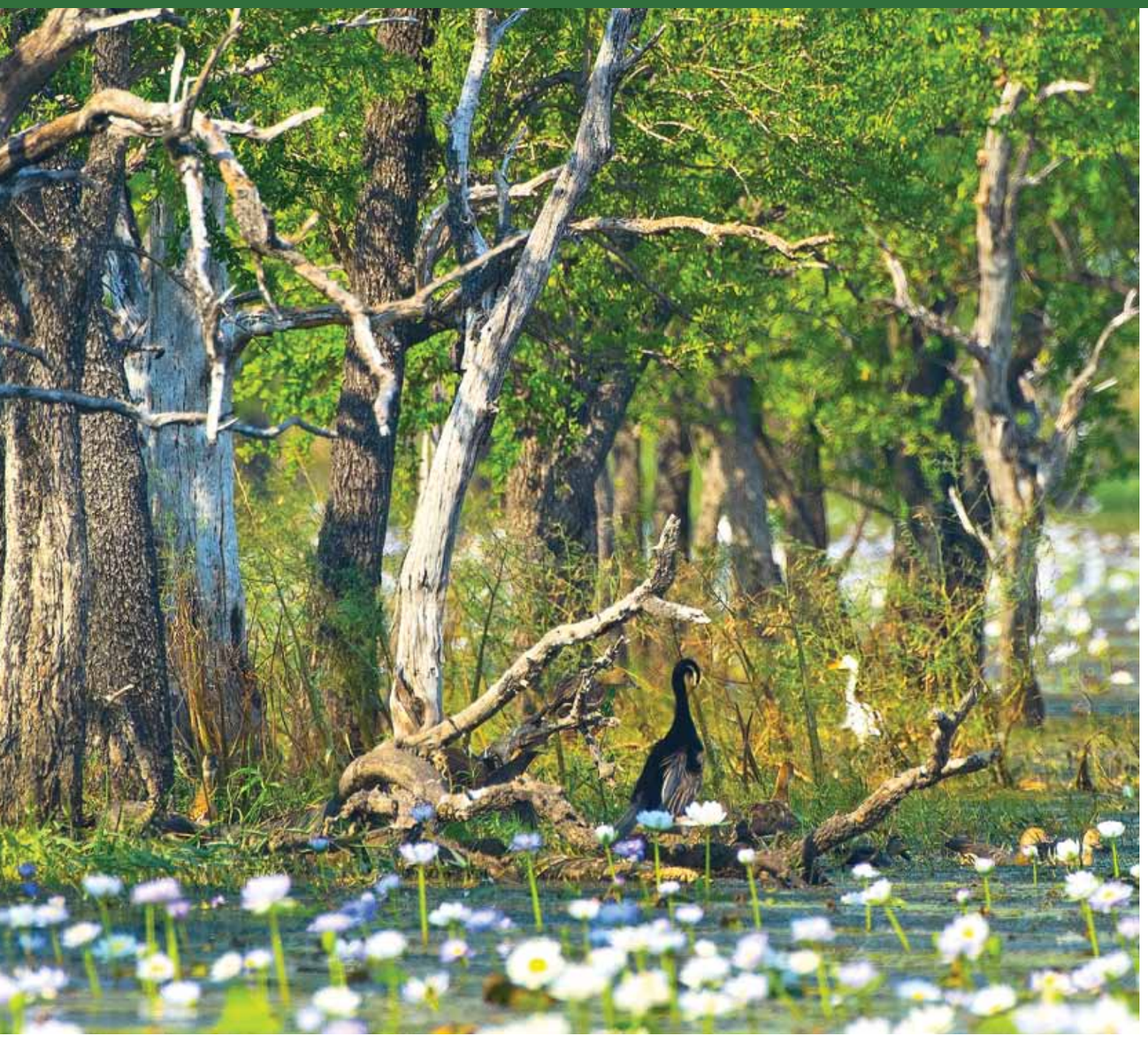
Eroding iceberg, Antarctica
Photo by Doug Thost

Outlook

At the moment, Antarctica is still in a comparatively good condition. However, the pressures on the continent and the surrounding ocean will increase. Numerous climate change processes are now under way that are likely to alter the physical Antarctic environment in our lifetime. The rate at which the physical environment of the region is changing appears to be faster than the rate at which organisms, especially those of a higher order, can adapt to the changes. Ecosystems and species populations will be affected. Organisms will have to adapt or they will disappear. Although many uncertainties still exist, some populations are already changing in size. Not all populations are decreasing but, in the long term, they may be outcompeted by species that can adapt to the changing ecosystems, or be replaced by species whose range is now extending from warmer climes into the Antarctic region. The most likely candidates to vanish are those that have adapted to narrow environmental limits, such as emperor penguins, and invertebrates that grow and develop slowly. New fisheries will open as species more adapted to warmer conditions than currently found in the Southern Ocean move south.

Climate change and the future of Antarctica remain topics of intense scientific research and debate as data analysis is still hampered by uncertainties and, in some areas, data deficiencies. Climate change is unlikely to be linear and various regions will be impacted on different scales, as the dissimilar developments in East and West Antarctica already demonstrate. Despite all uncertainties, the risks associated with climate change are significant and deserve our full attention.

Biodiversity



Parry Lagoons Nature Reserve, the Kimberley, Western Australia
Photo by Steve Parish

Main messages

Biodiversity has declined since European settlement.

Many of Australia's species are unique to this continent, and Australia is identified as one of the world's 'megadiverse' countries. However, there have been major declines in many components of biodiversity since European settlement and data on pressures suggest that many species continue to decline. Although we can reliably establish recent trends in distribution or abundance for only a small proportion of species, data on these suggest that population size, geographic range and genetic diversity are decreasing in a wide range of species across all groups of plants, animals and other forms of life. Unexpected declines in numbers of birds and mammals in northern Australia in particular suggest that trends might be worse than previously expected.

Despite promising investment by all jurisdictions in addressing the main pressures on biodiversity, pressures are not being substantially reduced, nor is the decline in biodiversity being arrested or reversed.

While all jurisdictions have appropriate goals in high-level plans, these are often not matched with implementation plans or levels of resourcing that are capable of achieving the goals. State of the environment reports from around the nation do not suggest any great improvement in biodiversity or reduction in pressures.

Most pressures on biodiversity that arise directly or indirectly from human activities appear to still be strong.

Those pressures that have decreased, such as land clearing, continue to have legacy effects that will continue for some years or decades. However, other pressures, such as those from invasive species, are generally increasing.

The major future drivers of change—climate change, population growth, economic development and associated consumption of natural resources—must be managed carefully if a sustainable relationship between biodiversity and human society is to be achieved.

Human activities have the potential to further reduce genetic, species and ecosystem biodiversity, which will seriously affect the delivery of environmental benefits to Australians and reduce our quality of life.

Data on long-term trends in biodiversity are limited, making it difficult to interpret the state or trends of major animal and plant groups in most jurisdictions.

The development of a new national approach to environmental information is intended to address this serious deficiency, which has now been identified by four national State of the Environment reports. The ability of all jurisdictions in Australia to develop and enact evidence-based biodiversity policy is severely constrained by the lack of such data.

Australia can improve its biodiversity management significantly.

Australian governments and nongovernment organisations are trialling a range of new approaches to managing our environment, including better stakeholder engagement and supporting connected corridors of vegetation. Australia is poised to build on these 'experiments' and, if wise decisions are made, could make major advances in biodiversity management. However, the legacies of past pressures like land clearing, ongoing pressures like invasive species and emerging challenges like climate change will take decades to address fully. Even the most optimistic scenarios envisage gradual, rather than immediate, progress.







Biodiversity

State and trends

Australia is one of the world's 'megadiverse' countries. Many of Australia's species, and even whole groups of species that comprise taxonomic families, are endemic (unique) to this continent. Between 7% and 10% of all species on Earth occur in Australia.

However, biodiversity in Australia has declined since European settlement. This decline is seen in all components of biodiversity—genes, species, communities and ecosystems—and the evidence from pressures suggests that many components of biodiversity continue to decline. The evidence from changes in extent, composition and quality of vegetation communities, and from case studies on selected species, points towards continuing decreases in population sizes, geographic ranges and genetic diversity, and increasing risks of population collapses in substantial proportions of most groups of plants, animals and other forms of life across much of Australia.

This trend is variable, because components of biodiversity appear to be persisting well in some areas, especially where human impacts are minimal, but declining significantly in others. Historically, problems have been greater in southern Australia than in the north, especially in woodlands and grasslands of the agricultural zones of the south-east and south-west. However, recent reports of significant decreases in abundance of small mammals and birds in northern Australia suggest that at least some components of biodiversity in the north are less secure than previously thought.

We have limited long-term data on virtually all groups of plants, animals and other organisms. This means that Australia has a very poor ability to assess rates and directions of change in elements of biodiversity, and to assess whether or not some components might be approaching points at which much more rapid change might occur, beyond which return to previous conditions might be very difficult or impossible. Research from around the world and case studies within Australia suggest that such threshold change is a possibility in a number of places and ecological systems. Where it occurs, it is likely to lead to irreversible loss of biodiversity.

Pressures

Despite promising investment by all jurisdictions in addressing the main pressures on biodiversity, state of the environment reports around the nation continue to conclude that the decline in biodiversity is not being arrested or reversed. Most pressures on biodiversity that arise directly or indirectly from human activities appear to still be strong and those that have declined, such as land clearing, continue to have legacy effects that will continue for years or decades.

The main pressures negatively affecting biodiversity have not changed greatly over the past three national State of the Environment reports, except that climate change has received greater recognition as a current and future driver of environmental change, and local climate has become a more prominent pressure as the nation has faced a decade of drought. Steps have been taken to limit clearing of native vegetation, but it remains a significant pressure in some places and the legacy effects of past clearing mean that the impacts are not yet reducing. Inadequacy of systematic information limits our ability to assess trends in other pressures with confidence, but available evidence and expert consensus suggest that pressures from grazing, invasive species, altered fire regimes and changed hydrology are still major and have been growing worse over the past decade. There is also the possibility that risks that are just emerging could become bigger problems (e.g. micropollutants, large-scale functional shifts in soils, geoengineering that goes wrong, misuse of genetic engineering, failure of protected areas and widespread failure of people to support action to protect natural assets).

For some or all of these pressures, improvements are possible once remedial actions start to take effect, but there is as yet no strong evidence of that improvement.

Effectiveness of management

Assessing the effectiveness of biodiversity management in Australia is made difficult by a lack of clarity in many jurisdictions about specific biodiversity conservation objectives and targets. In addition, long-term data on trends in biodiversity and their implications are very limited.

... biodiversity is much more than beauty and wonder, important though that is. It also underpins ecosystem services that—although not counted in conventional GDP—humanity is dependent upon.

Robert M May, *Why worry about how many species and their loss?,* PLoS Biology 9(8):e1001130, 2011

In general, the context of most past and current pressures on biodiversity is well understood. Most jurisdictions have detailed plans and strategies to deal with most current pressures. A notable exception is planning to address the dependence and impacts of Australia's human population on biodiversity and other natural resources; this remains poorly developed. Most other planning appears to be at least partly effective and improving.

Inputs and processes to address land clearing have improved greatly but it continues to be a significant pressure in some places and the legacy effects of past clearing are expected to continue to drive degradation and fragmentation of ecosystems for some decades. State of the environment reports from most jurisdictions have, for more than a decade, identified grazing pressures, invasive species and pathogens, altered fire regimes and changed hydrology as significant problems. Continued identification of these problems suggests that inputs or processes are not adequate to deal with these pressures (sometimes for understandable reasons). For most of these pressures, there is insufficient information to design good management or assess management effectiveness, and there is insufficient investment in filling knowledge gaps compared to the potential benefits of having that information.

Outlook

There is increasing recognition that protecting other species is a smart strategy for the long-term benefit of humans. For example, many of our crops, domestic animals, pharmaceuticals and other chemicals, building materials, fuels and many other products that have allowed humans to thrive in a range of environments come from other species. In addition, our ecosystems and the biodiversity that they support provide services that are fundamental to human life, such as regulation of the atmosphere, maintenance of soil fertility, food production, regulation of water flows, filtration of water, pest control and waste disposal. As Australia's population grows, the Australian community will need to decide how best to protect both biodiversity and human wellbeing.

Winter wombat, Overland Trail, Cradle Mountain National Park, Tasmania
Photo by Michael Boniwell

There is hope for the future. Australian governments and nongovernment organisations have been debating and trialling new approaches to biodiversity management, including ways to engage the right stakeholders at the right times and in the right places. This nation is poised to build on these trials and, if wise decisions are made, there is potential to make major advances. However, the legacies of past pressures like land clearing, ongoing pressures like invasive species and emerging challenges like climate change will take decades to address, so even in the most optimistic scenarios, we will not see overnight change.

Many risks facing biodiversity in the short and medium term relate to potential failure to take current opportunities for better management. A major challenge for Australians, not just those in government but across all sectors, is to understand the dependence of humans on ecological processes that are mediated by different elements of biodiversity; and to manage the size and distribution of our population, as well as our consumption of natural resources, in this context.

It is vital to improve the collection of information that will allow us to understand the effects of interactions and interrelationships between humans and biodiversity over the long term. Another key requirement for preparing for the future is to develop processes to support strategic thinking, anticipation of potential challenges and opportunities, monitoring of emerging change and preparation for change. Most of the potential risks and surprises affecting biodiversity also present opportunities if Australians think strategically, anticipate, prepare and act.

Heritage

Old wurlie (dust storm shelter), near Lake Torrens, South Australia
Photo by Peter Ahrens

Main messages

Our extraordinary and diverse natural and cultural heritage generally remains in good condition.

Australia is a complex, layered natural and cultural landscape in which unique geodiversity and biodiversity provide the stage for an ancient Indigenous culture and two centuries of post-colonial settlement history. The current condition and integrity of Australia's listed heritage generally appears to be good, with some deterioration evident over recent years. However, it is challenging to draw a single cohesive conclusion about the condition of Australia's natural and cultural heritage, given the diverse and fragmented nature of available information.

Australia is recognised internationally for leadership in heritage management.

We have a range of well-resolved processes for identification, protection, management and celebration of our heritage that should reduce pressures, minimise risk and retain those values that make our heritage places special.

Our heritage is being threatened by natural and human processes and a lack of public sector resourcing that does not reflect the true value of heritage to the Australian community.

Australians place a high value on our rich natural, Indigenous and historic heritage. However, the nation's protected natural and cultural resource does not include all the places with heritage value, nor is it truly representative. Management and protection of Australia's heritage is under-resourced and, despite our internationally recognised processes, some of the systems used to manage our heritage are cumbersome. This is out of line with community perceptions of heritage value. Consequently, our heritage is at great risk from the impacts of climate change, threats arising from development and pressures that flow from population growth.

Improvement will require change.

Comprehensive assessments, more flexible approaches and better resourcing are needed to support conservation. The future for Australia's heritage will depend on government leadership in two key areas: undertaking thorough and comprehensive assessments that lead to adequate areas of protected land and comprehensive heritage inventories, and changing heritage management paradigms and resource allocation in response to emerging threats.

Heritage

State and trends

Our heritage includes those places with natural, Indigenous or historic values that we have inherited and want to pass on to future generations.

Australia's listed natural heritage and reserved lands are in good condition, and the value of our natural heritage is widely recognised. However, neither private nor public natural heritage places are adequately protected and face threats from invasive species, fire, erosion, use and impacts on threatened species. The National Reserve System continues to improve, but reservation of a truly representative set of landholdings is hampered by factors such as perceived economic values.

There is increasing recognition of the importance of Australia's Indigenous heritage by all Australians. However, Indigenous heritage in Australia is inadequately documented and protected. Loss of language, knowledge and traditional practices continues to erode Indigenous cultural traditions and connections to country, and incremental destruction of Indigenous sites continues. Closing the Gap is a welcome initiative, as is the increasing involvement of Indigenous people in sustainable land and sea management.

There are many well-managed Australian historic heritage places that remain in good condition. However, statutory lists and registers are inconsistent and incomplete, and historic heritage conservation is not well supported by planning and assessment systems.

Pressures

Climate change, population growth and economic growth create a range of general pressures on Australia's heritage and some specific pressures on natural, Indigenous and historic heritage. Some of these pressures, such as those arising from our legacy of extensive land clearing, cannot readily be addressed through short-term management. Other pressures, such as changes to rainfall patterns or fire regimes, warrant responses even though the root cause cannot be removed.

Climate change is leading to higher temperatures, more rainfall in northern Australia and less elsewhere, rising sea levels, increasing frequency and intensity of wildfires, more soil erosion, and additional damage and destruction from extreme weather events. These pressures have high impact and will irreversibly damage our heritage if unchecked. Changes to our population can reduce resources for conservation in rural areas and create pressure for change and development in coastal and urban areas. Individual sites are also subject to neglect and vandalism or, conversely, damage from increased visitation. Economic growth affects heritage through development projects that directly threaten heritage areas and sites, large-scale resource extraction or growing tourism.

Pressures particular to natural heritage include the fast-growing number of invasive species, progressive loss of habitat, conflict in land use and tension between the potential economic value of land (e.g. for development, agriculture or mining) and its conservation.

Indigenous heritage in Australia is under pressure from loss of knowledge and tradition. This loss is manifest in social disconnection, extinction of language and discontinuation of cultural practices. Indigenous sites are subject to an ongoing process of incremental destruction associated with urban and industrial development that is often approved despite the identification of heritage impacts.

Historic cultural heritage is particularly threatened by pressures for redevelopment on both large and small scales. The impacts range from complete destruction to inappropriate change and adverse effects on associated attributes such as visual setting. Other pressures arise from population shift, including redundancy, neglect and decay. Inadequate incentives for private owners also threaten historic heritage. A wider range of management approaches would enhance the place of historic heritage in the community and facilitate effective conservation.

Effectiveness of management

Australia is recognised internationally for leadership in heritage management. We have a range of systems and processes for identifying, protecting, managing and celebrating our heritage that should lead to reduced pressures, minimised risk and retention of those

Places of cultural significance reflect the diversity of our communities, telling us about who we are and the past that has formed us and the Australian landscape. They are irreplaceable and precious.

Meredith Walker and Peter Marquis-Kyle, *The illustrated Burra Charter: good practice for heritage places*, 2004

values that make our heritage places special. However, despite our excellent understanding of the context for heritage management and good planning processes, the resources allocated to heritage identification and protection fall well short of what is needed to achieve effective outcomes.

The systems we use to manage our heritage are cumbersome: land reserves, inventories and statutes. These structures do not adequately identify, protect, manage, resource or celebrate our nation's cultural landscape. Consequently, our heritage is at great risk from the impacts of climate change, the threats arising from development and the resource implications of population growth.

Identification processes for Australian heritage are erratic. The National Reserve System offers a proactive approach to identifying a representative system of natural heritage places, and more than half of the 85 bioregions in Australia have at least 10% of their area within reserved land. In contrast, there is no national picture for Indigenous heritage (either tangible or intangible) and reliance is placed on 'blanket' provisions in legislation, leading to ill-informed decisions. Many historic heritage places have been identified, but the ad hoc approach of heritage registers means they are skewed towards particular aspects of history and a select group of values.

Heritage places in public ownership are often supported by well-prepared, values-based management plans. For nonpublic heritage places, planning systems, land zonings and related regulations do not necessarily help to achieve conservation outcomes, and some building codes and standards create pressure for demolition or inappropriate change. Decisions about development usually consider stakeholder perspectives, especially for Indigenous places, but the reactive nature of the process and an inadequate knowledge of the total resource tend to militate against conservation outcomes; heritage is identified only after a project is proposed and is therefore perceived as 'the problem'.

Resources available for heritage conservation are declining in real terms, as evidenced by the erosion of core funding for heritage in the 2011–12 Budget.

Porongurup National Park, Western Australia
Photo by Colin Totterdell and the Australian Government Department of Sustainability, Environment, Water, Population and Communities

Although some programs, such as the Jobs Fund initiative, have targeted heritage conservation with excellent outcomes, a combination of dwindling public sector resources (both human and financial) and progressive erosion of the specialist skills required for heritage management are threatening historic heritage values.

Outlook

The notion of outlook is a fundamental concept for heritage. Heritage is important for our perception of ourselves as Australians, and is part of the 'social glue' that binds communities together and expresses identity. Australians see natural and cultural heritage as important and vulnerable, but these sentiments are not reflected in the resources devoted to heritage assessment and conservation.

Australia's heritage includes a diverse array of places with a wide spectrum of different natural and cultural heritage values. Different types of place and different heritage values will vary in their resilience and response to current and future pressures, giving rise to a range of potential outlooks.

Overall, the outlook for Australia's heritage will depend on government leadership in two key areas: undertaking thorough assessments that lead to comprehensive natural and cultural heritage inventories and truly representative areas of protected land; and changing management paradigms and resource allocation in response to emerging threats and responding strategically based on integrated use of traditional and scientific knowledge.

Built
environment

Brisbane at dawn, Queensland
Photo by Nick Rains

Main messages

Australia's built environment is diverse.

Our built environment ranges from capital and regional cities to small towns in our coastal, rural and remote regions. Almost two-thirds (64%) of Australians live in the eight capital cities. In 2006, the proportion of Australia's population living in urban areas was 87%, up from 85% a decade earlier.

Australia's built environment faces many pressures and is only in a fair shape.

There are significant pressures on our built environment driven by population and economic growth, and climate change. An increasing need for space and buildings (our urban footprint), increasing traffic congestion and increasing consumption are affecting the livability and environmental efficiency of the built environment. Traffic congestion, in particular, is of growing concern. However, growth in traffic may be levelling, and use of public transport is increasing. Residents are also concerned about the look and design of their cities; in the biggest cities, there are concerns about whether the cities are clean, well maintained and unpolluted. Climate change is creating new risks by increasing the likelihood of weather events such as mega-storms.

The Australian built environment consumes significant natural resources, although this may be improving.

The residents and industries of the built environment consume natural resources, including water, energy and land. Waste generation within the built environment also has an impact on the natural environment. However, emerging evidence suggests that increases in the use of energy and water may be slowing due to improved technology, and better understanding and recognition of the need to reduce human environmental impact.

Recent government initiatives aim to improve the uncoordinated management of the built environment.

Management of the built environment is characterised by complex arrangements involving all levels of government, as well as the private sector, and these arrangements lack effective coordination. Recent initiatives of the Council of Australian Governments to reform capital city planning, as well as the recently released National Urban Policy, seek to address this issue. There are also concerns that insufficient investment has been made in infrastructure.

The outlook for the built environment is mixed.

The expected increase in the physical size of cities and increased traffic congestion will have negative impacts, but these may be offset by improved management and more efficient use of natural resources.

Built environment

State and trends

The built environment is the human-made surroundings where people gather to live, work and play. It encompasses both the physical structures where people do these activities and the supporting infrastructure, such as transport, water and energy networks.

Significant parts of Australia's built environment have aspects that are considered poor. In the largest cities, traffic congestion is a significant concern. In Sydney, satisfaction with the road network and traffic congestion had a very low rating of 13%, and low ratings were also recorded in Brisbane, Melbourne and Perth. There are also concerns about whether our cities are clean, well maintained and unpolluted. The attractiveness of Australian cities is considered to be only fair. In the smaller capital cities and other urban centres with populations of more than 100 000, traffic concerns are far less significant and the quality of the natural environment is higher. For smaller settlements, waste management is a concern.

Pressures

The major challenge facing our built environment is population and economic growth, which can lead to an increase in the physical size of cities, higher population densities, greater demands on natural assets within cities and increased congestion. These are impacting on the livability and environmental efficiency of our cities and towns. Climate change is also creating increased risks to the built environment through the greater likelihood of weather events such as mega-storms.

The built environment also puts pressure on natural resources, mainly through the use of land, water and energy resources. There is also significant waste generation, although there is emerging evidence that growth in the use of natural resources and waste generation may be slowing. Household energy use per person increased in the first part of the decade, peaking at 48.0 gigajoules per person in 2005–06. Since then, household energy use per person has fallen by about 5% to 45.5 gigajoules, reflecting more efficient use of energy.

Effectiveness of management

Urban policy and planning in Australia have varied with time and in different jurisdictions and institutions. The complexities of arrangements for managing the built environment in Australia have a negative impact on management effectiveness—in particular, because of challenges in coordination. Understanding of issues is good, but planning processes to date have only been partly effective, and the budget is often inadequate to deal with issues. There are concerns about the level of investment in infrastructure, particularly public transport. This leads to only a partially effective achievement of outputs and outcomes.

Recently, the Council of Australian Governments identified the need for reform to ensure that capital cities are better placed to meet the challenges of the future. The recently released National Urban Policy seeks to provide national leadership and guidance for states, territories, local authorities and the private sector in planning, managing and investing in cities.

Outlook

The outlook for the built environment is mixed. On the one hand, the increasing pressures on the built environment resulting from population and economic growth and climate change pose significant challenges. Increasing urban land use and traffic congestion are two areas of concern; however, congestion will be less of an issue if the recent levelling off of motor vehicle travel continues and if there is growth in public transport. Waste generation continues to grow. On the other hand, there is emerging evidence of more efficient consumption of water and energy. Furthermore, recent initiatives to improve urban planning should lead to greater capability to deal with emerging challenges.

When you look at a city, it's like reading the hopes, aspirations and pride of everyone who built it.

Hugh Newell Jacobsen (1929–)

Aerial view of the eastern suburbs of Melbourne, Victoria
Photo by Andrew Griffiths

Coasts

Point Lonsdale, Victoria
Photo by Michael Boniwell

Main messages

Coastal regions are under pressure.

Our coasts, as well as being some of our most iconic natural areas, are some of Australia's most heavily settled areas. The major pressures on biodiversity, ecosystem processes and natural and cultural heritage along Australian coasts include urban expansion; modification of habitats by urban and commercial developments and nearshore mining and dredging; changed flows of rivers into estuaries and coastal environments; disturbance of acid sulfate soils; loss and fragmentation of native vegetation; increasing use of coastal areas for food production (aquaculture); fishing and intertidal harvesting; rapidly growing numbers of invasive species and pathogens; tension between the potential economic value of land, including areas that are suitable for intensive agriculture, and its conservation; modest budgets for management of reserved lands; degrading conditions that affect buildings (e.g. wind, salt, inundation); low levels of recognition of what is culturally significant; and decline in connections between Indigenous people and coastal places.

Some trends in land use and management practices have reduced some pressures.

These include expansion of conservation and Indigenous areas, decline in the extent of native forest managed for wood production and a corresponding increase in the extent managed for conservation, and improvements in land-management practices that have reduced the flows of sediments and chemicals to the coast during major rainfall events.

There are examples of promising responses to coastal challenges by governments, working individually and together, but outcomes for some major issues are still far from ideal.

Local governments are expressing concern about the lack of guidelines, standards and national strategic approaches to address coastal development, growing populations and environmental impacts. There is significant uncertainty about how species and ecological systems will be affected by climate change. The recent independent review of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recommended a range of changes to the Act that would allow it to be applied more strategically and at ecosystem and landscape scales. Many of these recommendations have been accepted by the Australian Government. It remains to be seen whether action is sufficient and soon enough to allow assessment and successful management of the cumulative effects of small developments along the coastal strip.

Debate about coastal governance and management advanced with a 2009 report from the House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts.

The report, *Managing our coastal zone in a changing climate: the time to act is now*, noted that there is limited national collaboration and cooperation to achieve consistencies, efficiencies and agreements on issues such as variation in planning laws, capacities of local councils, monitoring coastal habitat change and legal liabilities. The report made 47 recommendations to address these issues. Most of these have been noted or accepted in principle by the Australian Government. As with responses to the review of the EPBC Act, the quality and timeliness of actions will be critical if existing challenges to coastal sustainability are to be addressed and looming ones prepared for.

The major emerging risks that remain incompletely addressed for Australia's coasts are those relating to climate change, especially sea level rise, and demographic change. The future of coastal Australia will depend largely on how rapidly these changes occur, how extreme they are, and how Australians prepare for and respond to them.

Awareness is growing that ecological, social, economic and cultural issues are interlinked and cannot be addressed separately. The future of our coasts depends on whether government and governance arrangements can be developed that allow a much more strategic approach to managing coastal resources, over spatial scales that match the scale of the challenges. Desirable futures are most likely if major reform of coastal governance is achieved in the next decade or sooner, which is possible, but not guaranteed.

Coasts

State and trends

Our coastal regions bring together many of the issues identified for other areas of the environment.

For inland waters, issues relevant to coasts include coastal river and estuary pollution, desalination, seawater intrusion, and impacts of water abstraction (removal) on flora and fauna. Overall, the management of coastal waters has improved greatly in Australia in the past decade, including some high-profile programs to ensure river and estuary health in metropolitan areas (e.g. Hobart and Brisbane). Widespread drought has increased tensions over water use, including in coastal areas, and this is likely to be an important consideration for coastal management in the future.

For land, major trends in land use that have both negative and positive impacts on coastal Australia include urban expansion in capital cities and major regional coastal cities, changed flow in rivers that influences freshwater and nutrient flows to estuaries and coastal environments, expansion of conservation and Indigenous areas, declines in the extent of native forest managed for wood production and increases in the extent managed for conservation, and improvements in land-management practices that have reduced the flows of sediments and chemicals to the coast during major rainfall events. Disturbance of acid sulfate soils remains a major consequence of coastal development, with significant environmental, economic and social costs to coastal communities.

For vegetation, impacts on the coastal strip are highly variable around Australia's coastline. Native vegetation ranges from very heavily cleared, with less than 10% remaining, in parts of Victoria and South Australia, through 31–50% remaining in large parts of the south-western and north-eastern coastal areas, to 71–100% remaining for most of northern Australia. The greatest reductions in native vegetation extent have been in eastern, south-eastern and south-western Australia.

For biodiversity, many plant and animal species are threatened by activities associated with Australia's coast-based population. The introduction of weeds and pest species has also contributed to national reductions in biodiversity, and in marine, estuarine and coastal productivity.

For the marine environment, there has been significant modification of coastal habitats by urban and catchment development, marinas, breakwaters, island reclamation projects, coastal and nearshore mining and dredging, harbours and shipping channels. A particular concern is the incremental nature of coastal development, which reduces the abundance of native vegetation and breaks down connectivity among remnant habitat patches. There has also been an increase in impacts of invasive species, including threats from pathogens.

For heritage, our coastal areas include many important wetlands, places of importance in the traditional culture and practices of Indigenous people, buildings associated with early European colonisation, historically important shipwrecks, threatened species and communities, and other places of natural heritage significance. Issues relevant to heritage on our coasts include degrading conditions (e.g. wind, salt, inundation), low levels of understanding of what is significant, a decline in connections between Indigenous people and coastal places, progressive loss of habitat, tension between the potential economic value of land and its conservation, and modest budgets for management of reserved lands.

Pressures

Major drivers of environmental change—climate change, population growth and economic growth—result in a range of pressures on our coasts. Events associated with climate variations have been major pressures on coasts over the past decade. Concern about coastal population growth has also been increasing for several decades. Urbanisation and coastal development for farming and industry are major pressures on habitats, biodiversity, water resources, air quality and heritage. The 2006 State of the Environment report concluded that 'most, if not all, of the issues identified and assessed in both the 1996 and the 2001 national state of the environment reports still remain to be resolved'.

Globally, the threat of rising sea levels as a result of climate change is one of the most concerning pressures on coastal communities, potentially affecting economic, social, cultural and environmental assets and processes. In Australia, a sea level rise of one metre or more during this century is plausible, and several hundred thousand homes are potentially at risk of inundation. Rising sea levels will also result in greater wave action on the shore, leading to increased rates of coastal erosion, particularly during extreme weather events, which are increasing in frequency. The capacity for coastal species to migrate inland to higher ground is limited in many parts of Australia by both the natural limits to the coastal plains and human-built structures such as seawalls, beach groynes and offshore reefs. Direct impacts on cultural sites, including many of significance to Indigenous people, are also possible. One of the major determinants of the future of Australia's coasts is how extreme and rapid the effects of climate change will be on coastal Australia.

You can tell all you need to about a society from how it treats animals and beaches.

Frank Deford (1938–)

Effectiveness of management

Recent research comparing Australian coastal governance with examples elsewhere in the world has concluded that, in many parts of Australia, the ability to adapt to emerging pressures, especially climate change, is low and declining. Recommendations include: (a) allocate authority and resources between levels of governance according to their effectiveness; (b) strengthen development rules and incentives to relocate as an unwanted threshold is approached; (c) allow for uncertainties by enabling rules and incentives to be changed when circumstances change; (d) reassign public and private benefits, costs, risks, uncertainties and responsibilities from governments to beneficiaries of development; and (e) see catastrophes as opportunities for change, not signals to automatically rebuild.

Local governments have also expressed concern about the lack of guidelines, standards and national strategic approaches to addressing coastal development, growing populations and environmental impacts. The concern among many stakeholders is that coastal development has proceeded in a piecemeal, uncoordinated way, risking the degradation of coastal assets before they are fully assessed or objectives set for their management. So concerned were coastal councils around Australia that, in 2004, they formed the National Sea Change Taskforce. The taskforce has been very active in developing and promoting solutions to state and Australian governments.

Freshwater Beach, Sydney, New South Wales
Photo by Matt Lauder

This debate took an important step forward in 2009, when the House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts handed down its report, *Managing our coastal zone in a changing climate: the time to act is now*. The report made 47 recommendations to address the lack of national collaboration and cooperation in coastal management. In addition, the recent independent review of the EPBC Act recommended changes to the Act that would allow it to be applied more strategically and at ecosystem and landscape scales. Most of the recommendations from these reports have been noted or accepted in principle by the Australian Government.

Outlook

Desirable futures—that is, futures in which harmony exists between the demands that humans place on coastal environments and the sustainability of coastal ecosystems—are most likely if major reform of coastal governance is achieved in the next decade or sooner, so that strategic action can be taken to identify and prepare for risks from sea level rise. Whether through incentives, regulation or both, coastal communities will need to consider ecological and other infrastructure and services in relation to population size. These changes will be important in addressing pollution, waste, recreation, tourism, invasive species and other pressures on coastal environments. Another requirement will be improved information on which species and ecosystems are being affected, and are likely to be affected, by human activities on coasts. The advanced level of dialogue and tangible plans for action that have been put forward are a good start towards desirable coastal futures. The quality and timeliness of actions will be critical if existing challenges to coastal sustainability are to be addressed and looming ones prepared for.

More about SoE 2011

Forest of red gums, New South Wales
Photo by Matt Lauder

The *Australia state of the environment 2011* report, which this document summarises, presents a comprehensive review of the state and trends of the environment; the pressures on it and the drivers of those pressures; management initiatives in place to address environmental concerns and the impacts of those initiatives; and its resilience and the unmitigated risks that threaten it. It also provides an overall outlook for the Australian environment.

The approach to reporting in SoE 2011 builds on an internationally accepted framework for environmental reporting—the DPSIR (drivers–pressures–state–impact–response) framework. This framework recognises a chain of causal links from driving forces, such as economic development, through to environmental impacts of human-induced pressures and the management responses aimed at mitigating those pressures.

For the first time in national environmental reporting, SoE 2011 goes beyond a descriptive summary of evidence to include graded 'report-card' style assessments of environment condition and trends, pressures and management effectiveness. It also includes discussions of resilience, risks, and future projections or 'outlooks'.

Information was used from a wide range of data sources (referenced in the full report), and from extensive consultations with experts in a variety of scientific disciplines across Australia. In many cases, workshops were held with experts to gather evidence and information, discuss issues and gauge opinion.

Independent peer review was used to validate and strengthen the content of the report and supplementary technical reports. Details of the peer-review process, comments from peer reviewers and responses from the SoE 2011 Committee on how feedback was incorporated to improve the chapters are available on the SoE website.

This summary is part of a suite of products that complement *Australia state of the environment 2011*. For more information, email ciu@environment.gov.au, phone 1800 803 772 or visit www.environment.gov.au/soe.

Future reporting

Tree fern, Russell Falls, Tasmania
Photo by Ken Duncan

Australia is positioned for a revolution in environmental monitoring and reporting. Researchers are adding to the amount of environmental information at an accelerating pace. Decision-makers are increasingly expected to bring that information to bear upon policy development, management practices and resource allocation. Improved national data collection and use of alternative data sources are vital for understanding and effectively managing important aspects of Australia's environmental and cultural systems.

As well as the data collected by government for reporting and management purposes, a substantial amount of environmental data is collected by the private sector for a variety of purposes. However, little of this information makes its way into consolidated national systems. A significant exception is the private–public partnership that operates in the geosciences, where exploration data have to be lodged with government, and eventually become publicly available. Of particular value would be partnerships with the resources sector, which collects rich datasets on our coastal and marine environments (where publicly available data are particularly scarce) as part of its environmental approvals and compliance processes; and the agricultural sector, where industry consultants collect a wide variety of environmental datasets on soil, water and pests.

However, collecting information is not enough. Creating and using systems that allow efficient access to environmental information remain a great national-scale challenge. Such systems would allow scientists and managers to analyse and make connections in the data, so that they can begin to understand the links among various aspects of ecological processes. It is also important that socioeconomic data relevant to environmental issues are available, so that connections between the environment and society can be understood. Finally, the usefulness of environmental and related data will be magnified if it can be effectively transformed into information products that are meaningful to a broad audience and relevant to the issues of today and tomorrow.

Innovations are being developed that focus on these environmental information challenges. Many of these are technical in nature: more intelligent and powerful monitoring, increased standardisation of measurement and reporting systems, and better data management and environmental modelling platforms. Other innovations will be in the policy domain, where national commitments to standardise and share environmental data between jurisdictions and industry offer significant value to environmental management. Some of the most significant innovations will be in how changes in environmental conditions are tracked—for example, through community-based environmental accounting, or through a national commitment to a set of benchmarks and standards for environmental and sustainability indicators. The Australian Government has a vital leadership role in this process.

Better information, combined with evidence-based decision-making, will support better management. In the coming decades, robust research and monitoring will help anticipate and deal with challenges and bring about positive outcomes for the Australian environment.

The SoE 2011 Committee encourages this innovation and commitment to increasing the value derived from environmental monitoring and reporting against agreed benchmarks and standards. We are convinced that this is an important key to improving the outlook for the state of the Australian environment.