Executive Summary

Australia State of the Environment 1996

An independent report

presented to the

Commonwealth Minister for the Environment

by the

State of the Environment Advisory Council

Australia: State of the Environment 1996
Executive Summary

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Foreword

This is the Executive Summary to the report *Australia: State of the Environment 1996*. The 1996 Australian state of the environment report was prepared by seven expert reference groups working under the broad direction of the State of the Environment Advisory Council, chaired by Professor Ian Lowe. Members of the Advisory Council and Reference Groups are listed on pages 46–47. With assistance from referees and consultants, the report draws upon the expertise of a broad section of the Australian research community.

In keeping with the open nature of the state of the environment reporting process, this Executive Summary has been produced to promote as wide an understanding as possible of the information that has been brought together and the conclusions that have been reached.

Copies of the complete report can be purchased from CSIRO Publishing at the address given on the opposite page.

Further information about the report and additional copies of this Executive Summary may be obtained from the Community Information Unit of the Department of the Environment, Sport and Territories, telephone 1800 803 772.

The Pilbara, Western Australia; Australia's arid zone contains unique ecosystems, plants and animals.

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It is with pleasure that I present the first ever independent and comprehensive report on the state of Australia's environment. It has been prepared by the State of the Environment Advisory Council and seven expert reference groups. With the added assistance of referees and consultants, the report has drawn on the expertise of a broad section of the Australian scientific community. The whole task has taken more than two years.

The report shows that Australia has a beautiful, diverse and unique environment. It finds that some aspects of Australia's environment are in good condition by international standards. Indeed, our approach to environmental management has won international recognition in several areas.

Unfortunately, the report also shows that Australia has some serious environmental problems. These need to be tackled with determination if we are to achieve the goal of ecological sustainability, as is the agreed aim of the Council of Australian Governments.

I want to emphasise that no single government or sector is to blame for the problems identified in this report. They are the overall consequences of a range of factors: population growth and distribution, lifestyles, technologies and our demands on natural resources.

I also want to stress that the report is not a catalogue of problems. Overall, it is very positive. Most of the problems identified do have solutions. The report details many successful initiatives to improve the state of our environment.

It is the hope of the Advisory Council that the report will be of use to the general community, managers and policy-makers. It should help all of these people to be better informed about the state of our environment, the pressures we exert on it and the effectiveness of our responses. The report provides a guide to priorities for all those who make decisions affecting our environment.

I am pleased to commend the report to you and, through you, to the people of Australia.

Ian Lowe
Chair
State of the Environment Advisory Council

23 May 1996

Overall Message

- This is the first ever independent and comprehensive State of the Environment Report for Australia. It links land, water, air, plants and animals, human settlements and how we value them.
- An independent advisory council and seven expert groups prepared the report. It draws on the knowledge and skills of more than 200 eminent scientists and other experts.
- The report shows that Australia has a beautiful, diverse and often unique environment which is a priceless heritage and should be a source of pride to all Australians.
- Some aspects of the Australian environment are in relatively good condition by international standards. In some areas our approach to environmental management has won international recognition.
- In many other areas it is not possible to decide whether our environmental management is adequate. We urgently need better information and understanding, which will require data collection and research.
- The report also shows that Australia has some very serious environmental problems. If we are to achieve our goal of ecological sustainability, these problems need to be dealt with immediately. This will be no small task.
- The problems are the cumulative consequences of population growth and distribution, lifestyles, technologies and demands on natural resources over the last 200 years and more.
- No single government or sector is to blame for these problems. We are all responsible. Changes are needed in government policies and programs, corporate practices and personal behaviour.
- Australians are among the most environmentally aware people in the world. All sections of the community now recognise the need to do more to tackle environmental issues.
- Most of the problems identified in the report do have solutions. The report details many positive and successful initiatives.
- Our actions have been most effective where they have taken a comprehensive and systematic approach, integrating different aspects of the overall problem. By contrast, failures tend to be piecemeal efforts that treat symptoms rather than underlying causes.
- Australia has an international responsibility to protect its rich biological diversity and its unique environmental features such as the Great Barrier Reef and other World Heritage Areas. We also have a national responsibility towards future generations of Australians.
- Australia has a better opportunity than perhaps any other nation to protect its environment and use its natural and heritage resources sustainably. We need to do much more if we are not to lose this opportunity.
- Progress towards ecological sustainability requires recognition that human society is part of the ecological system and integration of ecological thinking into all social and economic planning.

Towards ecological sustainability

Sustainable development

Sustainable development is arguably the central issue of our time. Its basic aim is to meet the needs of the present without compromising the ability of future generations to meet their own needs. Support for this goal is now widespread. Following extensive consultation with all community sectors, Australian governments adopted in 1992 a National Strategy for Ecologically Sustainable Development (ESD).

The strategy defines ESD as a pattern of development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. One of the functions of this report is to assess progress towards the goal of ecological sustainability (see the box on page 10 for more details about the approach taken in the report, including its objectives).

Information needs

State of the Environment reporting is an important step in the essential process of refining the knowledge base on which decisions about the environment are made. That base is currently inadequate. For example, while we believe that more than 90 per cent of vertebrates and higher plants in Australia are identified and described, it is estimated that only about 50 per cent of the invertebrates and simpler plants are identified. We know even less about other species such as fungi and bacteria. With such limited knowledge, it is impossible to assess the impact of human activity on biodiversity — a critical aspect of ecosystem health and resilience.

Australia lacks the integrated national systems and databases to measure environmental quality, manage it and evaluate the effectiveness of that management. Until these deficiencies are rectified, we will remain unable to truly answer the question of whether our pattern of development is genuinely sustainable.

Our lack of knowledge and understanding of environmental issues emerges again and again in the report as a major obstacle to sound environmental management.

What we need to sustain

Sustainable development requires the maintenance of the following three key components of the environment:

- *biodiversity:* the variety of species, populations, habitats and ecosystems
- *ecological integrity*: the general health and resilience of natural life-support systems, including their ability to assimilate wastes and withstand stresses such as climate change and ozone depletion
- *natural capital*: the stock of productive soil, fresh water, forests, clean air, ocean, and other renewable resources that underpin the survival, health and prosperity of human communities

The Wollemi pine — a relic from the age of dinosaurs

The discovery in December 1994 of a new kind of tree near Sydney caused great excitement, as Australia's flora is considered to be well known. The Wollemi pines (*Wollemia nobilis*) reach about 35 m in height with a main trunk up to one metre in diameter. The discovery of a new species of tree, especially one that grows to such an impressive height, is extremely unusual. The habitat of the trees — protected steep-sided canyons north-west of Sydney, which acted as refuges from fires that frequently burn the adjacent plateaus — contributed to their continued existence. The tree, given the common name of 'pine', is a conifer but is closer to the Norfolk Island pine than to the true pines. The discovery is a dramatic demonstration that parts of our biological heritage remain unknown.

Global environmental context

We now recognise that we are part of a global ecosystem and an increasingly integrated global economy. This poses a new set of questions for sustainable development. Issues such as ozone depletion and climate change demand global responses. International action is succeeding in reducing the use of ozone-depleting substances. Halting and reversing the trends in greenhouse gas emissions will be much harder, requiring a fundamentally different approach to the use of energy.

Agenda 21 — a program of action for sustainable development worldwide — was adopted in 1992 by more than 178 governments, including Australia, at the UN Conference on Environment and Development. It highlights the pressures on the natural environment from population growth and associated poverty in the developing world, and unsustainable patterns of consumption in the industrialised world. Increasing global pressures to reduce resource consumption and waste production are a part of Australia's future.

There are various indications of global environmental stress. More than two-thirds of the world's bird species are in decline, vulnerable or threatened with extinction. Frog populations appear to be declining, although it is uncertain why this is happening. Coral reefs appear to be in trouble. Globally, key indicators of food production per head are falling, including production of beef and mutton, cereals and seafoods.

The Australian environment: constraints and driving forces

Australia's natural environment is a product of its geological history and the manifold impacts of human activity. Any analysis of the state of the environment has to begin from an appreciation of the unique geological, physical and biological characteristics of the country which constrain our actions. It has also to consider the driving forces which are altering the state of the natural world, including population size and distribution, and the patterns of human activity.

Australia is an old, weathered, eroded landscape, flat and generally dry, with a highly variable climate, especially rainfall. Its unique plants and animals reflect its long isolation from other land masses and their wildlife.

The population of Australia when Europeans arrived is estimated to have been between 300 000 and 1.5 million. Seventy years later, the European population had reached one million. By 1995, the total population stood at 18 million. Adding to the environmental pressures created by the increasing

Background to the report

State of the environment reporting

The principle of ecologically sustainable development is now widely accepted and supported in Australia. It acknowledges that our way of life depends critically on a range of natural assets — air, soil, water, forests and other biological systems — and that these assets must be safeguarded.

Sustainable development is impossible without adequate and accessible information about the environment. State of the Environment (SoE) reporting is a powerful tool for providing this information — to the public, industry, non-government organisations and all levels of government.

It allows regular reports on agreed sets of national indicators (once these are established) of changes and trends in environmental conditions, in much the same way as well-accepted economic indicators are used to report on the state of the economy. It describes the effects of human activities on the environment, and their implications for human health and economic well-being. It also provides an opportunity to monitor the performance of government policies against actual outcomes.

Thus SoE reporting can act as a report card on the condition of the environment and natural resource stocks.

Principles and objectives

Six principles, embracing rigour, objectivity, cooperation, openness, global vision, and ecological sustainability, guide SoE reporting. Key objectives include:

- To provide accurate, timely and accessible information about the condition and prospects of the Australian environment.
- To increase public understanding of these issues.
- To facilitate the development of an agreed set of national environmental indicators, and to review and report on these indicators.
- To provide an early warning of potential problems.
- To report on the effectiveness of policies and programs designed to respond to environmental change, including progress towards achieving environmental standards and targets.

Approach

The approach to SoE reporting in Australia is based on a modified version of the OECD's 'pressure-state-response' model. The model is based on the concept of causality: human activities exert pressures on the environment; these change its state or condition; society responds by developing or implementing policies that influence those human activities, and so change the pressures. Australia has modified this model to include cultural aspects of the environment, to recognize the inherent variability and lack of knowledge about the Australian environment and to allow for an interactive rather than a linear model.

Indicators

Developing a nationally agreed set of indicators for Australia is a high priority for SoE reporting. These are physical, chemical, biological or socio-economic measures that can be used to assess natural resources and environmental quality. Preparing this SoE report has involved selecting a 'first generation' of environmental indicators. These indicators provide a good foundation for future development.

Structure

Chapter 1 sets out the background to the report and its purpose and is summarised in this box.

Chapter 2 gives a general description of Australia's physical, biological, social and cultural landscape, and of how we have come to our present situation.

Chapters 3 to 9 discuss in detail the key facets of the contemporary environment, employing the pressure-state-response approach. The seven aspects of the environment are: human settlements, biodiversity, atmosphere, land resources, inland waters, estuaries and the sea, and natural and cultural heritage.

Chapter 10 draws together the major findings to give the State of the Environment Advisory Council's overall assessment of our progress towards ecological sustainability.

permanent population is the growing influx of tourists, who are often attracted to our most precious natural and cultural heritage areas. Other factors that influence our impact on the environment include the distribution of people (Australia is one of the most urbanised of all nations, with most people living in a few large coastal cities), our lifestyles and our use of technology.

For at least 50 000 years, people have lived here and modified the environment, harvesting its biological resources, using fire to alter it, changing its shape and imposing their patterns of settlement. Since 1788, the human impact has increased dramatically, because of both the rapid growth in population and the introduction of farming, forestry, mining and large towns and cities.

Climate variability has been a constant problem for Australians because it causes natural fluctuations in vegetation and fauna. It is not this variability, or other features such as the poor soils, that puts pressure on our environment, but human activities that fail to take sufficient account of these features.

Two fundamental difficulties hinder the development of appropriate responses to environmental problems. First, we may not know the cause or causes, which can involve a complex interaction between a variety of factors; and second, there can be a long time lag between changes in human activities and any observable differences in natural systems.

Even where we are clear about the problems and what needs to be done, our institutional arrangements — such as those between and within governments — make it difficult to deliver coordinated responses.

Key issues

The report identifies several issues that are critical to assessing and improving the state of Australia's environment:

A systems perspective

Our responses need to embrace a systems approach that reflects the complexity of the natural world and the cultural values associated with it. There is little likelihood of a coherent policy emerging from the traditional compartmentalised approach in which different departments or different levels of government each handle different, small parts of the problem.

Biodiversity

Biodiversity is the variety of all life forms: the different plants, animals and micro-organisms, their genes and the ecosystems of which they are a part. Australia has one of the widest ranges of biodiversity of any nation, with a large proportion of its species found nowhere else in the world. The major threats to biodiversity are: land clearing; loss of native forests; introduced species; the absence of

Elabana Falls, Lamington National Park; biodiversity values include beauty, tranquility and also vital ecosystem services: natural vegetation acts as an effective filter for sediment in catchments. When the vegetation is removed, the run-off becomes discoloured with sediment and creeks silt up.

The Leadbeater's possum, *Gymnobelideus leadbeateri,* is an endangered species in Australia. Breeding programs at zoos are an important way of ensuring the survival of the species.

Incision of small stream resulting from land use.

some representative ecosystems in national parks and other reserves; and the lack of knowledge about our biodiversity.

Water

How we use the land affects the state and use of inland waterways, which in turn affect estuaries and the sea. A systems approach is essential: land management is more likely to be effective if it is based on biophysical regions, water management on integrated catchments, and oceans on an integrated approach to marine ecosystems. Water-related issues include scarcity, quality and nutrient loads, waste water disposal, rising groundwater and associated salinisation, and pollution of coastal waters.

Land degradation

There is widespread concern about the degradation of farm land. Pressures include clearing, over-stocking, cropping on marginal land, irrigation, and introduced species such as rabbits and goats. These pressures lead to a range of problems including erosion, salinisation, acidification, waterlogging and poor soil structure.

Ballast water is regarded as a significant vector for the introduction or translocation of exotic or pest species such as sea slug *Godiva quadricolor*.

Global climate change

Global warming and other climatic changes which result from increased emissions of greenhouse gases pose a serious problem, both in terms of the direct impacts and the potential to aggravate other environmental problems such as biodiversity loss. While Australia's total emissions of greenhouse gases are small in global terms, our per capita emissions are among the highest in the world. We do not appear to be making much progress in stabilising, let alone reducing, these emissions.

The urban environment

While the environmental problems of our large cities may be less serious than those of many smaller settlements in terms of the impact per person, they are among our most important environmental concerns because of the scale of human activity these cities represent. Issues include: the dispersed, low-density character of our cities (and coastal development), and the resultant dependence on the private car for transport; urban waste, including vehicle emissions, stormwater and garbage; the destruction of remnant native vegetation and habitats; the continuing growth of urban settlements; and the protection of heritage in urban areas.

Social and cultural issues

The biophysical environment is imbued with cultural significance and encompasses the dwellings and settlements in which we live. The report identifies four key social and cultural issues: various forms of social stress such as emerging pockets of poverty and high unemployment; the loss of physical and cultural well-being of many indigenous Australians; the loss of cultural continuity under conditions of rapid change; and the inadequate protection of heritage.

These issues can affect the natural environment as well as being important in their own right. One criterion for sustainable development is social

integrity; for this reason alone, social problems deserve attention. In the case of the first of the four key social and cultural issues a growing number of 'pockets of poverty' pose potential problems for the social environment, and a reduction in the size of households is contributing to urban sprawl. The other three issues expose inadequacies in the conservation of our natural and cultural heritage. Losing our past makes it more difficult to evaluate our future. Sustainable development will only be possible if it is firmly based on our natural and cultural heritage.

Overview of the state of the environment

The report aims to provide an objective picture of the state of Australia's environment. It contains both good news and bad about the state, and reveals some responses that are exemplary and others that are ineffective. Both positive and negative aspects are important in strengthening our resolve to achieve a development trajectory that is genuinely sustainable. One — the good news and the successes — offers hope; the other — the problems and the failures — encourages urgency.

The good news

In some areas Australia's environment is not threatened, and is in relatively good condition, especially compared with most other parts of the world.

- Unlike most industrial nations, we have no significant problem with sulfur dioxide and acid rain. Levels of some urban air pollutants, including lead, carbon monoxide, nitrogen oxides and large particulates, have declined in recent years.
- Urban drinking water quality is generally very good, as is the standard of our food, with low levels of chemical residues and metals.
- Oceans and estuaries, away from major cities and developed coastal areas, are in relatively good shape.
- Our urban housing is generally of good quality, and a well-established system exists for protecting significant places.

The bad news

Elsewhere, however, we are experiencing serious environmental problems.

- The loss of biological diversity is perhaps our most serious environmental problem. Whether we look at wetlands or saltmarshes, mangroves or bushland, inland creeks or estuaries, the same story emerges. In many cases, the destruction of habitat, the major cause of biodiversity loss, is continuing at an alarming rate.
- In cities, transport systems, stormwater and sewage and other waste disposal continue to have substantial adverse impacts on the environment, including biodiversity and water quality.
- Inland waters in southern Australia are in poor shape, largely because of poor management. Too much water is being taken from some systems, and nutrient and salt levels are of concern. Algal blooms may be becoming a more serious problem. In northern Australia, there is still time to prevent deterioration.
- The hole in the protective ozone layer over the Antarctic is growing larger and deeper, exposing humans and other species to increased levels of harmful ultra-violet radiation. Present indications suggest that the layer will slowly recover.
- Soil erosion from agricultural land remains a problem, especially given our poor, shallow soils

In general, Australian seafoods are low in contaminants.

Alf Neal, an elder of the Kuku Djungan tribe working with a botanist to extract a pollen core from a lake at Ngarrabullgan in North Queensland in order to investigate changes in the environment and in patterns of Aboriginal land use over time.

Kakadu National Park (left); a healthy wetland and Lake Wyangan, near Griffith, NSW (below); a degraded wetland

and low rates of soil formation. Other forms of degradation, such as salinisation, are also not being adequately addressed. The continuing productivity of our agriculture may be at risk.

- Some aspects of the environment experienced by indigenous Australians remain poor. Indigenous people have not shared the improvements in health enjoyed by other Australians over the past 50 years. Their health remains a serious problem that is yet to be adequately addressed. The loss of traditional indigenous languages has been profound. Both these issues are important to our cultural heritage.
- Old growth forests continue to be logged.

The uncertainties

In a number of areas there is not enough information to assess the situation. Some areas warrant concern rather than alarm.

- The status of some marine species, including mammals, reptiles and some types of fish, is of concern.
- Some types of forest are threatened with disappearance and we cannot be certain that others are adequately protected to ensure their survival.
- Our system of reserves is patchy, with areas of poor biodiversity being better protected than areas of high biodiversity, because the poorer areas also have less economic value.
- For a range of issues, including aspects of urban air quality, water systems and natural and cultural heritage, the available data do not permit a clear description of the national picture.

Overview of responses

Australia's response to the state of its environment has been effective in some areas, in others questionable, and in yet other areas, either inadequate or counter-productive.

Commendable actions

Australia is doing well — in some cases setting an international example — for a range of issues.

- The listing of natural areas and cultural landscapes under the World Heritage Convention, and their subsequent protection, is a real success story, as is the increasing provision for other forms of reserve status, and the strengthening of State and Territory heritage legislation.
- Some of our structural solutions to complex management problems, such as the Great Barrier Reef Marine Park Authority, the Murray–Darling Basin Commission and the Board of Management of Uluru-KataTjuta, are recognised internationally as good models of response.
- The recent decision to limit further diversion of water from the rivers of the Murray–Darling Basin is a landmark in Australian water management. An interim cap is in place and a final cap will be made by 30 June 1997. However, in many cases water diversion remains above acceptable levels.
- New Fisheries Acts have recently been introduced throughout Australia with the aim of managing resources within the principles of ecologically sustainable development and economic efficiency in the face of increasing fishing pressure. This has resulted in much improved fisheries

management, but it is too early to judge the effectiveness for those species which were over-fished.

- The Landcare program has been very successful in mobilising land-owners and communities to improve environmental conservation and encourage the adoption of sustainable land-use practices. The program needs to be broadened to embrace a more integrated, systems approach.
- Australia has taken prompt and purposeful action to phase out ozone-depleting substances such as CFCs. This action puts us ahead of international targets. We have also accelerated the transition to unleaded petrol.
- State governments, notably Queensland, Western Australia and South Australia, are acting to increase the use of renewable energy such as solar power.
- Recycling schemes have dramatically reduced the volume of waste in some areas; the Better Cities demonstration programs, water efficiency appliance schemes, the Commonwealth's National Pollutant Inventory and Cleaner Production are, like many other initiatives, helping to improve environmental standards.

Questionable actions

Another group of responses is questionable.

- The short-term economic objective of reducing the price of power presently drives reform of the electricity industry. With this goal, energy use — and so pollution and greenhouse gas emissions — is likely to increase.
- The move to regulate aircraft noise by taxation and legislation is a positive step, but only came after widespread public concern about the noise levels associated with the new runway at Sydney airport.

Poor responses

Finally, there are areas where our responses seem inadequate or counterproductive.

- The national ability to manage the environment is continually hamstrung by structural problems between different areas of government. Standards vary from State to State, and State and Commonwealth governments frequently battle over environmental issues. The recently established National Environment Protection Council will address some of these issues.
- Adequate measures are not yet in place to combat the threats to biodiversity.
- Concerns remain about whether the changes to fisheries management are enough to reverse the decline in some fish stocks.
- Despite the commitment to ecologically sustainable development, some government agencies still see their primary role as promoting economic development, with little regard to environmental costs.

There is growing community concern about the environment. 'Friends of Merri Creek' replant the banks of the creek with native grasses.

- While land clearing is restricted in some States, in others it continues to be tolerated and even encouraged.
- Urban planning in general, and transport planning in particular, are still problems, with few effective attempts to contain urban sprawl or discourage the use of private cars. There is no concerted attempt to redirect our pattern of energy consumption in a sustainable direction.
- Australia is falling short of its greenhouse gas emission reduction targets. In recent years, energy-related carbon dioxide emissions have grown much faster than the OECD average.

Conclusions

Environmental awareness has increased dramatically in the past decade, penetrating all sections of the community. There is now ready acceptance of national and international environmental standards. Environmental management is growing rapidly, as a profession and a practice. However, we do not yet have an integrated, system-based approach to the management of natural resources. Until we do, environmental management will be characterised by *ad hoc* responses to urgent, emerging problems. Despite the adoption of national strategies for ecologically sustainable development and conservation of biological diversity, there is little evidence that this broader approach and commitment to sustainability has been fully integrated into decision-making.

Overall, economic planning appears to take little account of environmental impacts. It is assumed that the first priority should be a healthy economy, and that problems can always be solved using the wealth created. The economy is a subset of human society which, in turn, is part of the environment. Progress towards sustainability requires recognition of this fundamental truth, and a willingness to build environmental thinking into our economic planning.

Australia — the island continent

Australia is the smallest of the world's seven continents, but the sixth largest country and the only country to occupy an entire continent. It is the only permanently inhabited continent that lies wholly in the southern hemisphere.

The southern hemisphere is mainly water, and is markedly less affected by human activities than the northern. Australia lies in relatively unpolluted air and sea. Its comparative isolation means that transboundary pollution is not as significant an issue as it is for many northern hemisphere countries.

Continental Australia

Many of Australia's unusual features are important in assessing the state of its environment.

It is the world's lowest continent. Australia has the lowest average elevation and the lowest absolute relief (the difference between highest and lowest points). This is partly a result of its geological stability. Its few mountain ranges are very low by world standards, and most of the country is a broad flat platform.

It is geologically stable. Australia has some of the oldest land surface on Earth. Much of this surface has been weathering and eroding for long periods of geological time. It is the only continent that has no tectonic mountain building or active volcanoes.

It is the driest inhabited continent. Australia receives the lowest annual average rainfall, apart from Antarctica. Its latitude puts it in a low rainfall zone. The lack of mountains, which tend to increase rainfall, is also a factor. More than one-third of Australia is classified as arid (receiving an average of less than 250 mm of rain a year), and another third is semi-arid (receiving 250–500 mm).

Its climate, especially the rainfall, is highly variable. Averages can be very misleading: in some places much of the annual rainfall can fall in a week or so; in others, the annual rainfall can vary from a fraction of the annual average to several times its size. Changes in sea temperature and atmospheric pressure associated with a suite of events known as the El Niño–Southern Oscillation, or ENSO, are a major cause of this variability.

It has fewer sizeable rivers and less run-off than any other continent, except Antarctica. The low rainfall means that, for its size, Australia has few sizeable rivers, and accumulates little fresh water on its surface.

It has large, but diminishing, groundwater resources. Australia is well provided with (under)groundwater that can be tapped with bores and wells. The largest source, the Great Artesian Basin, is huge, underlying about 22 per cent of the continent. Groundwater is being used much faster than it is replenished.

Its soils are generally poor. Australian soils are among the most nutrient-poor and unproductive in the world. This is mainly because of the country's geological stability, with many soil components having been leached out during the land's long exposure to weathering. The dryness also mitigates against the formation of rich, deep soils. Less than 10 per cent of the country has reasonably productive soils that can sustain intensive agriculture or dense vegetation.

It is a land of natural hazards. These are part of Australia's natural environmental variability. Drought, flood, fire, earthquake, storm and tropical cyclone are normal features of the land. Large fires occur somewhere in Australia every month of the year. Much of the native vegetation is adapted to fire, and many species need it to reproduce. The frequency of fires is not just a result of the hot and dry climate, but also its variability. Wet periods allow vegetation to build up as fuel for fires in dry times. The flammability of eucalyptus oil and the dry leaves of many plants also contribute.

It is rich in minerals. Australia has more than 20 per cent of the world's stock of recoverable bauxite, iron ore, uranium, mineral sands and diamonds. Coal is another important mineral resource.

Australia's seas

Australia's seas are an important part of its environment, both in their own right and because of the influence they have on the terrestrial environment, especially its climate.

Mosaic of Australia taken by satellites at a height of 830 to 850 kilometres. The map is a mosaic of ten satellite pictures collected so as to minimise cloud cover over the land.

Although the satellite only has one visible band, the colour scheme used in the image has been selected so as to simulate natural colour. The visible channel has been used in the blue, a band which highlights vegetation has been coloured green, and the red is the 'thermal band' which highlights features which are dark in the visible.

The mosaic was prepared by GEOIMAGE Pty Ltd (in Brisbane) and published with permission.

Australia sits between three ocean basins — the Pacific, Indian and Southern. Its ocean territory, as defined by the 200-nautical-mile Exclusive Economic Zone (EEZ), covers about 12 million square kilometres, about one and half times its land area (7.6 million square kilometres). It is the third largest EEZ in the world.

The adoption of the EEZ in 1994 gives Australia rights to explore, exploit and manage the zone's natural resources. It also imposes responsibilities to conserve the zone's rich diversity of living organisms.

Australia has several important marine features.

It has warm ocean currents. Australia has a major ocean current passing down each side of the continent, bringing warm water from the tropics to both east and west coasts. This feature is unusual, as most other continents have a 'cold' current, from the polar regions, running along one side, and a 'warm' current, from the tropics, along the other.

Its seas are not highly productive by world standards. The lack of an upwelling of cold waters, rich in nutrients and oxygen, is one reason. Another is lack of run-off from the land and the low level of nutrients in the run-off. Despite the large size of our fishing zone, the total fish catch is low by world standards, ranking about 50th by production (although most of the catch has a high unit value).

It has the world's largest coral reef. The most famous feature of Australia's seas is the world's largest continuous coral reef complex, the Great Barrier Reef. The reef extends about 2500 kilometres along the north-east coast. Near its southern end lies the world's largest sand island, Fraser Island. Both the reef and the island are World Heritage Areas.

Australia's biology

Australia's unique physical characteristics have made its biology distinctive.

It has a rich biodiversity. Australia is one of the twelve most biologically diverse countries in the world, a status owed to its size, long isolation and many climatic zones.

Many of its plants and animals are unique. Australia has a very high degree of endemism — that is, many of its plants, animals and micro-organisms are not found elsewhere in the world. This is because they have evolved in isolation.

Its vegetation is dominated by two genera of trees — Eucalyptus and Acacia. Acacias are widespread in southern continents, although Australian species are endemic. Eucalypts are mostly confined to Australia and New Guinea, with a few species occurring in other islands to our north.

Most plants are sclerophylls. A particular quality of much of the Australian flora is the hard, dryish, leathery, spiny or small leaves. These plants are called sclerophylls. They are well adapted to dry conditions and low-nutrient soils. Their leaves lose less moisture and are tougher, so lasting longer and needing replacement less often.

Australia is the undisputed world centre for marsupials. Several families of marsupials (mammals whose young develop in a pouch) occur in South America and one species in North America; Australia has about 144 marsupial species.

Monotremes (mammals that lay eggs) are even more special. Only three species exist — the platypus and two echidnas (one is in New Guinea). There is also a large number of native placental mammals (in which the young develop in the womb), mainly bats, rodents and marine mammals.

Its tropical rainforests are small but rich. Australia's tropical rainforests are distinctive — again a consequence of the continent's long isolation. While covering only 0.1 per cent of the land area, they contain a large proportion of Australia's known plant and animal species. Many rainforest species have not been scientifically described, and there are probably many more, especially invertebrates, that remain undiscovered.

Introduced species have 'run wild'. In the past 200 years, introduced species of plants, animals and micro-organisms have caused dramatic and irreversible changes to the natural ecology. They range in size from the Asian buffalo to disease-causing viruses. Introduced animals such as the fox, cat, rabbit, goat and pig have been directly or indirectly responsible for many of Australia's native mammal extinctions. Exotic fish such as the European carp and trout have damaged freshwater environments. Introduced plants such as *Mimosa* and rubber vine are taking over large tracts of land and waterways. An introduced fungus, *Phytophthora cinnamomi*, is a major cause of dieback, a disease threatening whole ecosystems.

Australia's people

The first humans arrived in Australia at least 50 000 years ago. Prehistorians believe that they came from the north, through south-east Asia, probably at a time when sea levels were lower than now and sea voyages shorter. Waves of migration probably occurred over thousands of years. By about 20 000 years ago, people had spread to all parts of Australia.

The early Australians did not use agriculture. The persistence of hunting and gathering may well have been an adaptation to the low productive potential of most of the country. The people clearly knew a great deal about the land's resources and how to care for certain plants.

Like all people, they modified their environment to suit their needs — mainly through the use of fire. It is possible that continuous hunting, coupled with vegetation changes resulting from regular burning, drove some animals to extinction and changed the species composition of the fauna.

With the arrival of Europeans just over 200 years ago, the rate of human-induced environmental change accelerated dramatically. Sent in the belief that the land had boundless potential, the first European settlers found the environment harsher than anticipated, and both it and the original inhabitants soon came to be seen as generally hostile and alien. Introduced disease, especially smallpox, and violent conflict had a devastating impact on the indigenous people.

As the newcomers colonised more and more land — clearing it and introducing European agricultural practices and exotic plants and animals — the prevailing view changed from early dismay to unrealistic expectations. The environment could be 'tamed' to create great wealth. As the colony prospered, visions grew of a wealthy and powerful nation, rivalling the United States.

Only much later did people begin to realise that Australia's environment has many limitations, and that its 'development' has come at great cost.

Human settlements

Australia is a highly urbanised nation, with about 85 per cent of its population living in towns and cities of 10 000 or more people. Although these settlements occupy less than one per cent of the country's total land area, they have a pervasive influence on the natural environment.

The report examines Australian settlements in terms of the resources they consume, the wastes they produce and their 'livability'— a measure of social amenity, health and well-being. This 'extended metabolism' model allows settlements — whether capital cities or remote indigenous communities — to be assessed in terms of their human outcomes as well as their impact on the natural environment.

Australian settlements have high livability by international standards and, in general, it is improving. However, these patterns vary considerably between and within settlements.

Our settlements have higher metabolic flows — that is, they use more resources and produce more wastes — than those in other industrial nations. These flow levels have been increasing, both in total and per person, over the past few decades, as illustrated by the following examples.

- Domestic water consumption has risen significantly over the past 20 years because of the rising population and increasing use per head. Sydney's total consumption per head (domestic and industrial) rose 25 per cent between 1970 and 1990, from 144 to 180 tonnes.
- Australia's primary energy consumption per head increased by 37 per cent between 1970 and 1990, and its energy consumption per unit of GDP has fallen only marginally since 1970, while some other countries have reduced theirs by more than 30 per cent.
- Food consumption per head (measured by energy content) increased by more than 70 per cent

The changing shape of Australian cities

The image of a typical Australian family lifestyle includes a detached suburban home, surrounded by a garden, with a car or two in the garage. The house is one of millions of similar dwellings in our large cities by the sea. This picture, although it does not portray the diversity of Australian lifestyles, does reflect the country's unique settlement history, and especially the influence of 20th century technological and economic processes.

People in settlements do not like to spend, on average, more than about half an hour in travelling to destinations. This has been a universal pattern throughout history, and has determined the shape of cities as the means of transport changed:

- The walking city (up to 1860) could only spread five kilometres, so tended to be compact (100–200 people per hectare), with narrow streets. Remnants can still be seen in places like The Rocks, in Sydney, and Fremantle. This urban form remains common in many developing countries.
- The transit city (1860–1940) could spread 10–20 kms, and tended to be built along railways or tram lines, with medium-density houses and work locations (50–100 people per hectare) and a strong emphasis on the Central Business District. Many European cities retain this urban form.
- The automobile city (from 1940 on) could spread 20–40 kms, wherever roads were built, and is much more spacious, with a still lower density (10–20 people per hectare). The CBD is mainly an office centre, with most other work dispersed to the suburbs. Many cities in the United States and Australia are like this.
- The nodal/information city has emerged only in recent decades in large cities where travel times, even by car or train, from the periphery to the centre exceed half an hour. This form comprises a range of smaller subcentres with the same global information processing and networking capabilities as the CBD, as well as other urban services. Although linked to the rest of the city, these subcentres can create a large degree of self-sufficiency within their urban region.

Two processes are occurring simultaneously to help shape the new nodal/information city:

- Suburbanisation of work and services to outer areas, along with new housing, allows many dispersed locations to exist almost independently of the historic core of the city. Such subcentres include Parramatta (Sydney), Dandenong (Melbourne), Joondalup (Perth), Elizabeth (Adelaide) and Ipswich (Brisbane).
- Reurbanisation of core, inner and middle areas enables more households to have ready access to the major employment opportunities in these areas, revitalising older subcentres. Examples include Chatswood (Sydney), Box Hill (Melbourne), Fremantle (Perth), Tea Tree Gully (Adelaide) and Toowong (Brisbane).

Apart from these processes, there are two other significant patterns of development:

- Exurbanisation — the growth of low-density settlements (for example, hobby farms) spreading beyond the official boundaries of cities, but functionally linked to them.
- Conurbanisation — the merging of previously independent provincial cities such as Geelong, Wollongong and Newcastle, and the Gold Coast and Sunshine Coast, with their nearby metropolitan cities via freeways and other transport links.

Urban planners continue to argue about the relative merits of suburbanising and reurbanising strategies. Meanwhile Australians are choosing both approaches. Surveys show that the numbers wanting to move outwards are roughly matched by those wanting to move inwards. The development processes resulting from both demands need to be managed more carefully and to incorporate more effectively the principles of ecologically sustainable development, community development and quality urban design.

Sustainable infrastructure plans

The Commonwealth government now requires sustainable infrastructure plans for all new developments involving Commonwealth funding. The provision of infrastructure and services — power, communication and transport, water and sewerage etc — helps to shape the patterns of settlements, including city structures and regional development.

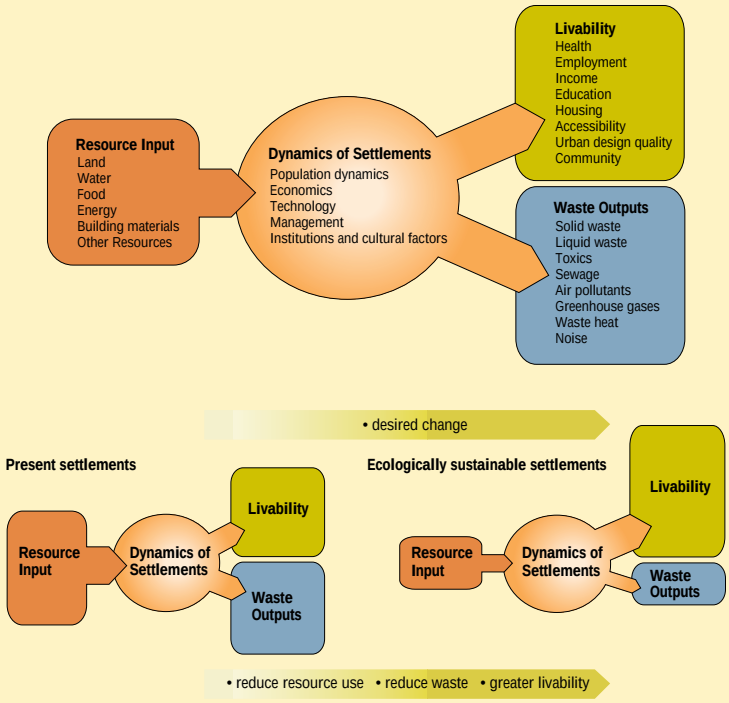
The plans evaluate the provision of infrastructure and services in settlements in terms of their impact on environmental indicators. Such plans could become part of standard urban development practice. They can be applied in a number of situations:

- Large growing cities — to enhance development processes such as reurbanisation and suburbanisation; transport and information infrastructure planning that integrates economic, ESD and social justice objectives; affordable housing, especially in the 'pockets of poverty' emerging in Australian cities; and social and economic infrastructure, such as education and employment programs in poor areas.
- Provincial towns — to facilitate the move of industrial processing to regional towns where there are economic and environmental gains.
- Coastal areas — to address the ecological pressures of the rapid growth of coastal settlements and ascertain where net economic and environmental gains exist in further coastal development.
- Declining rural areas — to reverse rural decline and to move towards regional economic development based on restructuring and diversification.
- Remote areas — to improve provision of infrastructure to remote settlements, especially indigenous communities; to increase economic involvement in growth industries; and to improve social amenity and health.

Initiatives to reduce the metabolic flows of Australian settlements and also improve their livability often require a holistic approach because they have to be considered or adopted by a wide range of government agencies and other organisations. This applies particularly to State of the Environment reporting for human settlements, as it extends across so many different areas of responsibility.

Australian cities have high solid waste generation rates. Although recycling is growing there is much more to do.

The extended metabolism model of human settlements



Most coastal settlements discharge sewage without tertiary treatment. The near ocean environment absorbs 10 000 tonnes of phosphorus and 100 000 tonnes of nitrogen per year.

Trends in resource flows, Sydney, 1970 and 1990

	Sydney 1970		Sydney 1990	
Population	2 790 000		3 656 500	
Resource inputs per head				
Energy (MJ)	88 589		115 377	
Domestic		10%		9%
Commercial		11%		6%
Industrial		44%		47%
Transport		35%		38%
Food intake[a] (tonnes)	0.52		1.0	
Water (tonnes)	144		180	
Domestic		36%		44%
Commercial		5%		9%
Industrial		20%		13%
Agricultural/gardens		24%		16%
Miscellaneous		15%		18%
Waste outputs per head				
Solid waste (tonnes)	0.59		0.77	
Sewage (tonnes)	108.0[b]		128.0[c]	
Hazardous waste (tonnes)	n/a		0.04	
Air waste (tonnes)	7.6		9.3	
Carbon dioxide (kg)	7210.0		9050.0	
Carbon monoxide (kg)	204.9		177.8	
Sulfur oxides (kg)	20.5		4.5	
Nitrous oxides (kg)	19.8		18.1	
Hydrocarbons (kg)	63.1		42.3	
Particulates (kg)	30.6		4.7	

Notes:
(a). Derived from food sales data, not consumption data. It reflects an increased use of primary foodstuffs (eg grains) in the production of meat and processed foods.
(b). Includes stormwater,
(c). Waste water within sewerage systems only

Source: NSW Office of Energy, 1995; ABARE, 1991; 1993; ABS, 1993f; 1995e; EPA NSW, 1993; Nix, 1973; Butlin, 1976; SWB 1991a, b.

between 1967 and 1992, not because we ate more, but probably because of more energy-intensive production and more wastage in processing.

- Australia produces more municipal solid wastes than other industrial nations — 681 kg per person per year, compared with an OECD average of 513 kg.

Cities

The big cities are generally more efficient in their metabolic flows than smaller cities and country towns. The large cities also tend to enjoy better livability. This suggests there is little to be gained environmentally by dispersing urban populations into other areas, especially the non-urban coastal zones, which are growing rapidly. Much can be done to reduce metabolic flows while further improving livability within cities.

On the other hand, the large cities, notably Sydney, are experiencing 'capacity' problems associated with photochemical smog, stormwater and waste water that demand changes if the cities are to continue to grow. Global constraints must also be faced, especially those arising from the greenhouse effect.

Within the large cities, the more compact core and inner areas consume fewer resources and produce less waste per head than outer and fringe areas, although there are some pressures on their infrastructure. Livability levels are similar across each large city, except the urban fringe, which suffers poorer social amenity (access to public transport, and health, educational, sporting and recreational facilities etc).

Livability is declining in emerging 'pockets of poverty' found right across the city. Unlike many cities in the United States, which have deteriorating cores, Australian cities are undergoing simultaneous processes of suburbanisation, with new suburbs being created at the fringe, and reurbanisation, with older areas being redeveloped. Suburbanisation is still dominant in terms of population numbers, but reurbanisation now accounts for more than 30 per cent of housing and 50 per cent of commercial development.

Towns

The urban fringe and coastal areas, particularly in northern New South Wales and Queensland, are expanding more rapidly — and less sustainably — than other settlements. This is evident from their metabolic flows, their pressure on sensitive environments and their livability.

Many inland towns are stagnating economically, many face significant 'capacity' problems with water and waste management, and are generally starved of adequate technological investment because of their limited growth potential.

The populations of the more remote provincial towns — apart from tourist centres — are declining, and this is reflected in their reduced livability. It suggests that population decline is not good for settlements that need investment and community commitment to address long-term

environmental and livability problems. Diversifying the productive base is an economic, social and environmental priority.

Remote settlements

The number of remote indigenous communities is growing. They have low metabolic flows, but face some 'capacity' issues (for example, firewood). They also have extremely low livability on all indicators, particularly health. Powerful cultural forces have driven this 'return to the country', which is only now being helped by appropriate technology. The communities lack basic infrastructure, as well as social and economic development programs to improve livability.

Management

Australian settlements are falling well short of the environmental objectives expressed by governments. Increasing use of resources per head, growing population, and patchy implementation of the legislative, social and technological innovations necessary to ameliorate the environmental impact of settlements, all contribute to this situation.

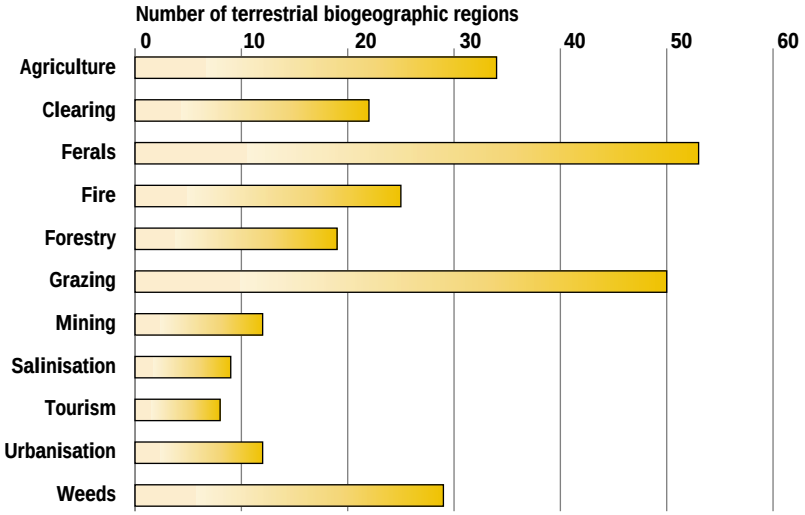
The new technique of sustainable infrastructure planning, which evaluates the environmental impact of infrastructure and services, together with innovative Commonwealth government programs such as Better Cities and Cleaner Production, can reduce metabolic flows in all Australian settlements and increase their livability. State of the environment reporting can assist this integrated process, particularly where local capacities need to be more carefully assessed and monitored.

Many indigenous communities are facing critically low levels of social amenity and health.

Human Settlements: key threats to sustainability

Issue	Detail	Comment
Livability of remote indigenous communities	Critically low levels of social amenity and health are evident in indigenous communities.	A major problem. The situation is not improving.
Livability of inland towns	Many inland towns are declining in population with a consequent reduction in livability.	The situation is deteriorating.
Livability of coastal settlements	Despite the attraction of coastal locations and lifestyles, rapid growth of coastal areas is associated with a serious lack of economic opportunities and services.	Of some concern, with the situation steady.
Coastal development	Coastal lands are ecologically sensitive. The greatest concentrations of population and new developments are now on the coastline thus putting great pressure on it.	Coastal habitats are being destroyed and degraded by overdevelopment. The situation is deteriorating.
Metabolism of big cities	Australian cities are comparatively high in their consumption of resources (energy, water, land and building materials) and production of wastes (air, liquid and solid).	Although big cities have lower per capita flows than small cities, many resource usages and waste flows have been increasing at an unsustainable rate. Capacity problems are being experienced in the airsheds, streams and coastal waters of all big cities.
Livability of big cities	Sprawling car-based suburbanisation continues, though there is an increasing trend towards reurbanisation of older suburbs. Emerging 'pockets of poverty' stemming predominantly from unemployment are appearing across the cities.	Significant problems could emerge if negative trends continue.

Number of terrestrial biogeographic regions in which each of 11 threatening processes are considered important by State and Territory conservation agencies



Note: Australia has 80 biogeographic regions.

Bioregional planning

Biodiversity conservation and management are bedevilled by the large number of public agencies involved, administrative boundaries that do not have any particular physical, geographic or ecological basis, and the cumulative effects of many developments. One proposed solution to this situation is bioregional planning, which provides an over-arching mechanism to integrate options for the conservation and management of biodiversity.

Bioregional planning is defined as an ecological and social framework within which governments, business and community interests share responsibility for coordinating land-use planning and devising development options that meet human needs in a sustainable way without further loss of biodiversity.

Traditional planning is effective in controlling site-specific development proposals, but has proved ineffective in dealing with cumulative, off-site, and incremental impacts such as habitat fragmentation and soil salinisation resulting from land clearance. Bioregional planning can be used to integrate the often ad hoc approaches to land-use planning to achieve a more holistic, systems-based approach.

We will not reconcile production and conservation values simply by expanding the national system of reserves and national parks. Too often, reserves have been established for economic or political, rather than biological reasons. As a result, ecosystems that are unproductive — because of poor soil, for example — are well protected, while those in more productive areas may not be protected at all. Many ecosystems and species will be protected only if the environment is managed according to natural rather than economic or political boundaries.

Bioregional planning and management are designed to overcome the major problems associated with fragmented decision-making, or the tyranny of small decisions. However, much more knowledge is required to implement this approach, not all of it biological. While scientific information on the biodiversity of a region is essential, we also have still to work out ways of creating the infrastructure to include all interested parties and to resolve the conflicts between them.

Biodiversity

Biodiversity is the variety of all life forms, and comprises the different plants, animals and micro-organisms, their genes and the ecosystems of which they are a part.

Life in Australia has evolved in relative isolation for at least 50 million years. As a result, Australia possesses a rich diversity of unique and unusual plants, animals and micro-organisms.

About 85 per cent of flowering plants, 84 per cent of mammals, more than 45 per cent of birds, 89 per cent of reptiles, 93 per cent of frogs and 85 per cent of inshore, temperate-zone fish are endemic to Australia — that is, they are found nowhere else in the world. While a majority of these species have been studied, relatively little is known about the vast and less visible world of invertebrate animals and micro-organisms. In all, Australia is home to more than one million species, but less than 15 per cent have been described.

We depend on biodiversity for our survival and quality of life. The most significant impediment to the conservation and management of biodiversity is our lack of knowledge about it and the effects of human population and activities on it.

Preserving Australia's biodiversity is important for four reasons:

- *Ecosystem processes:* biodiversity underpins the processes that make life possible. Healthy ecosystems are necessary for maintaining and regulating: atmospheric quality, climate, fresh water, marine productivity, soil formation, cycling of nutrients and waste disposal.
- *Ethics:* no species — and no generation — has the right to sequester Earth's resources solely for its own benefit.
- *Aesthetics and culture:* biodiversity is intrinsic to values such as beauty and tranquillity. Many Australians place a high value on native plants and animals, which contribute to a sense of cultural identity, spiritual enrichment and recreation. Biodiversity is central to the cultures of Aboriginal and Torres Strait Islander peoples.
- *Economic:* Australian plants and animals attract tourists and provide food, medicines, energy and building materials. Our biodiversity is a reservoir of resources that remains relatively untapped.

Pressures

The greatest pressures on biodiversity come from the demands on natural resources by increasing populations of humans, their affluence and technology. Habitat modification — especially the removal of native vegetation for agriculture, urban development (including the depletion of coastal habitats) and forestry — has been, and remains, the most significant cause of loss of biodiversity.

Exotic organisms — including species introduced for production purposes and introduced diseases, and native species whose range and/or abundance has changed because of human activities — also exert pressure on biodiversity. Other pressures are harvesting of native species, pollution from

Pressures on biodiversity

The demands on natural resources arising from increasing populations of humans and their industrial and other activities give rise to a range of pressures on biodiversity, including the following examples.

Habitat modification

Australia has developed very rapidly (in some regions taking 200 years to achieve what took 10 000 years in other parts of the world). Since European settlement, almost 70 per cent of all native vegetation has been removed or significantly modified, including the loss of about 40 per cent of total forest area and 75 per cent of rainforests. As much land was cleared over the last 50 years as over the previous 150 years. Native vegetation is being cleared at a rate of more than 600 000 hectares per year — about half the rate of clearing in the Brazilian Amazon in 1990–91.

Introduced and dispersed species

These exert a major pressure on biodiversity. They eat native fauna and flora and compete with native species for habitat. They include exotic organisms, such as species introduced for production purposes, weeds, feral animals, introduced disease organisms, and native species whose range and abundance have changed.

Introduced plants present an acute ecological problem. They account for about 15 per cent of the total flora and about one-quarter of them either are, or having the potential to be, serious environmental weeds. These include rubber vine, blue thunbergia, two semi-aquatic grasses, para grass, giant sensitive plant and athel pine. The rubber vine, for example, entangles trees and other vegetation, eventually smothering them. It is spreading through the river systems of Queensland, destroying riverside vegetation at an alarming rate.

At least 18 exotic mammals have established feral populations in Australia, including cats, dogs, foxes, rabbits, pigs, water buffalo, donkeys, goats and horses. Cats and foxes have been blamed for the decline, and possibly the extinction, of several native animals. For example, studies of the red-tailed black cockatoo in Western Australia showed that feral cats caused the failure of up to 20 per cent of nests by climbing into tree hollows to prey on nestlings. Exotic fish such as the trout and European carp have also caused widespread damage.

Introduced invertebrates have attracted little attention because they are small and little is known about their impacts. However, some are both obvious and destructive. For example, the European wasp, first seen in the Sydney area in 1978, has spread widely. It preys on native insects, including commercially important pollinators, and attack soft fruits. In Europe, colonies are generally annual, and the onset of winter kills all the wasps except the queens, which start new colonies each year. In Australia, with its warmer winters, the colonies have become perennial, growing very large with huge numbers of wasps.

Introduced species can carry diseases that infect native species. For example, the introduced fungus, *Phytophthora cinnamomi* causes the disease, dieback, that is devastating many native trees in some parts of Australia. The disease can kill 80–100 per cent of infected individuals in susceptible groups such as Banksias and Grevilleas, threatening entire ecosystems.

Some native species are spreading or becoming more abundant because of clearing, cropping, grazing and other activities. These may be as serious a threat to biodiversity as exotic species. For example, much of the pastoral land in the central-western areas of New South Wales and Queensland have become densely infested with woody weeds — shrubs that occur naturally but have spread at the expense of other natives because of overgrazing and changed fire patterns.

The galah has spread over much of Australia because of the creation of vast areas of suitable habitat (grasses, cereal crops and abundant water), bringing it into competition with other birds. Carnaby's Cockatoo, a black cockatoo of south-western Australia, has disappeared from a third of its range in the past 25 years; competition from galahs over nest sites has contributed to its decline.

Pollution

This is an actual and potential threat to biodiversity, particularly in regions close to industrial sites and urban areas. Pollutants include heavy metals and hydrocarbons in urban stormwater, and fertilisers, insecticides and herbicides in run-off in rural and inshore areas. For example, sewage effluents and agricultural run-off are high in nitrogen and phosphorus, but low in silica. This has resulted in a major shift in species composition in some marine areas from a plankton community dominated by diatom algae, which need silica, to one dominated by dinoflagellate algae, which do not. Dinoflagellate blooms cause a range of serious problems, from massive fish kills associated with 'red tides' to paralytic shellfish poisoning in humans.

Mining

Mine operations, both terrestrial and marine, are numerous, but generally involve a small area. However, their local impact on biodiversity can be intense. Long-term and extensive operations such as open-cut coal mines and mining of coastal sand dunes have severe impacts on local biodiversity.

Climate change

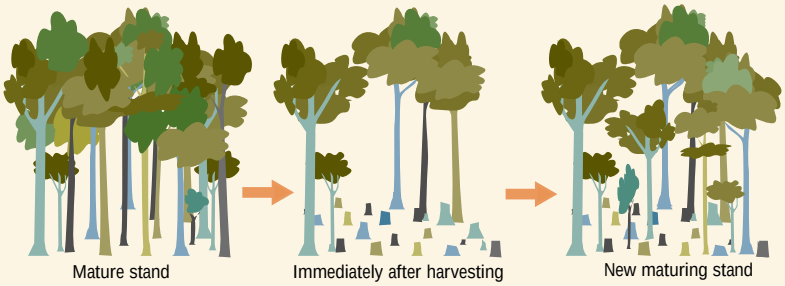
The habitats of many of Australia's endangered vertebrates may contract significantly if the climate warms. Under one scenario, 46 of the 57 endangered species would contract in range. However, it is difficult to assess the impact of climate change on biodiversity because it depends largely on the rate of change and the compounding effects of other pressures such as habitat loss and fragmentation.

industrial sites and urban areas, and fertilisers and other chemicals used in agriculture and forestry. Climate change, as yet difficult to assess, could also have a serious impact.

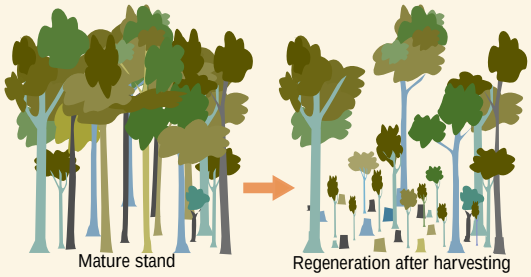
The effects of different logging methods on forest ecosystem structure

Clearfelling is the localised removal of most or all trees followed by burning of debris. The soil tends to be exposed to erosion, and regrowth is often less diverse, both in terms of species and the age of trees.

Modified clearfelling keeps some trees for conservation purposes such as mammal habitat and to allow further growth of immature trees. The resulting forest retains a greater diversity of species and age classes.



Shelterwood logging in highland forests minimises snow or frost damage to seedlings. Shelter trees are retained and then felled once some regrowth is established.



Selective logging removes individuals or patches of trees at relatively short intervals. There are many variations including focus on a particular species or thinning of small trees. The general aim is to retain diversity of species, sizes and ages.

Source: Resource Assessment Commission, 1992.

Impacts

Every ecosystem in and around Australia, with the possible exception of the deep ocean, has been modified in some way, with varying impacts on biodiversity. However, there is limited information on which species were present when Europeans arrived here, which are present now and which have been lost. It is difficult to respond to the pressures and the changes in the state of biodiversity without basic information on what that state is and how biodiversity is distributed.

For the land animals and plants about which we know enough to assess their current state, the trends are disturbing. Some 5 per cent of higher plants, 23 per cent of mammals, 9 per cent of birds, 7 per cent of reptiles, 16 per cent of amphibians and 9 per cent of fresh-water fish are extinct, endangered or vulnerable. Australia has the world's worst record of mammal extinctions. In the past 200 years, we have lost 10 of 144 species of marsupials and 8 of 53 species of native rodents.

Management

Since the 1980s, several major international agreements have addressed biodiversity as a key issue. It has become an important organising principle in a number of national policy statements, and is now influencing decision-making at national, State and regional levels. In particular, the Commonwealth, State and Territory governments have endorsed the National Strategy for the Conservation of Australia's Biological Diversity to guide the implementation of policies related to biodiversity.

However, governments are not providing enough resources to give effect to these policies. A lack of coordination between Commonwealth, State and local government is also a major impediment.

Australia is one of 12 nations in the world that contain major repositories of biological diversity. It is the only one that is industrially developed, has a relatively small human population, and occupies an entire continent. Thus we have a good opportunity, as well as the responsibility, to balance conservation, human population growth and demands, and economic development.

This can only be done by making substantial changes to the way we manage the land and ocean. Many current practices are not sustainable, and biodiversity-based industries such as agriculture, pastoralism, forestry, fisheries and tourism often erode the very resources upon which they depend.

Australia lacks major, co-ordinated programs for the discovery, monitoring, management and sustainable use of biodiversity. New strategies, particularly ecologically sustainable development, give us the opportunity to provide world leadership in the wise use of natural resources, including their conservation for future generations. Without this comprehensive approach, the future is bleak for much of Australia's unique flora and fauna.

Policy responses

Since the 1980s biodiversity has become the focus for a number of national policy statements and is now influencing decisions made at national, State and local levels. Australia is party to numerous major international agreements relating to biodiversity, and governments have available a range of policy instruments, including legislative, economic and social, for its conservation.

However, increased awareness of biodiversity issues by governments has not yet been translated into over-arching Commonwealth, State or Territory legislation for the conservation of biodiversity. While legislation relevant to the management of flora and fauna has increased since the 1960s, little of it specifically identifies the conservation of biodiversity. The fragmented approach to this task is illustrated by the 11 Commonwealth Acts and the many State Acts that govern the management of native plants and animals.

Also, the effectiveness of legislation varies widely, depending on the capacity and willingness of the responsible agency to use its powers and the political agenda of the government of the day.

A range of economic instruments are being developed to help achieve the sustainable use of natural resources. Few have been introduced specifically for managing biodiversity, but some are potentially beneficial for it. The Commonwealth also funds biodiversity research through CSIRO, the Australian Nature Conservation Agency and universities.

The National Strategy for the Conservation of Australia's Biodiversity relies on community support and community-based actions for its successful implementation. Programs involving collaboration between the community and government include the National Landcare program, the Community Biodiversity Network, Greening Australia and One Billion Trees.

Biodiversity: key threats to sustainability

Issue	Detail	Comment
Effects of human population and consumption	The overwhelming causes of the decline in Australia's biodiversity result from the human population, their lifestyles, technologies and demands on natural resources.	The situation continues to deteriorate as population and demands on natural resources increase.
Condition of ecosystems	Most terrestrial, freshwater and marine ecosystems are altered in structure and function to some extent.	Few ecosystems remain in a largely natural condition. The situation is deteriorating.
Distribution and abundance of species	Many species are undescribed or poorly studied; of those that are described, many are lost or threatened.	The loss of and decline in species continues and is cause for national concern.
Changes in genetic diversity	Little is known for most species although there is strong evidence of loss of genetic diversity for some.	While the degree of genetic diversity is unclear, it is almost certainly declining.
Land clearance and related activities	Land clearing destroys and modifies ecosystems, thus threatening biodiversity. The past extent and continuing rate vary greatly between States and Territories.	This is the single largest threat to biodiversity. The situation is deteriorating as threatening activities continue.
Impacts of introduced species	Most terrestrial, freshwater and marine ecosystems are affected or threatened, as are many native species.	Impacts have often been severe and the situation continues to deteriorate.
Harvesting native species	Some species have been and are being over-exploited. There are detrimental effects on habitat and non-target species.	Harvesting of native species is an important pressure on biodiversity in some areas. The situation is deteriorating.
Lack of knowledge of biodiversity	This affects ability to develop strategies for achieving sustainable production without further detrimental effects on biodiversity.	The knowledge base, while still inadequate, is slowly improving.
Effectiveness of conservation measures outside conservation parks and reserves	Most biodiversity will continue to rely on areas outside the system of conservation parks and reserves.	Better integration of management approaches in the local, regional and national spheres is required.
Adequacy of protected areas	The number and extent of protected areas is increasing but nature conservation is generally a residual land use in agricultural districts.	Some ecosystems and species are represented well, others poorly.
Adoption of integrated ecosystem-based management of natural resources.	This is necessary for achieving sustainable production without further detrimental changes in biodiversity.	Bioregional management requirements are partially recognised, but enormous efforts are still required to fully develop and implement them.

The large dust storm that swept across Melbourne in February 1983 made many urban dwellers aware of wind erosion. However, the fine haze in previous days, which went largely unnoticed, carried more soil into the Southern Ocean than did the dramatic dust storm. The dust storm was calculated to be about two million tonnes and the cost of replacing nutrients at around $4 million.

Australia's climate

The Australian climate includes many climatatic zones — temperate climates (with a small alpine region) in Tasmania and the southern mainland, Mediterranean climates in the south-west and south-central areas, and subtropical and tropical climates in the north. More than 75 per cent of the continent is arid or semi-arid, and it has less rainfall and less run-off from its rivers than any other inhabited continent.

The climate is highly variable. Over the eastern half of the country, the variability results, in part, from the continent's location near the 'centre of action' of the so-called Southern Oscillation. Occurring over a cycle of two to seven years, this is a large disturbance in the circulation of the atmosphere over Australia and the eastern Pacific, which is closely linked with the occasional remarkable warming of the surface waters of the central and eastern Pacific Ocean, known as an El Niño.

At one extreme of the cycle, when the central Pacific Ocean is warm and the atmospheric pressure over Australia is relatively high, the El Niño–Southern Oscillation, or ENSO, causes drought conditions over eastern Australia; at the other extreme, it is associated with more frequent tropical cyclones and floods in the Australian region.

Since 1950, mean temperatures in Australia have risen by about 0.1–0.2°C per decade, reflecting similar trends worldwide and due mainly to an increase in night-time temperatures. Records also show an increase in cloudiness over Australia, a trend which has been recorded in other parts of the world. These trends are consistent with the enhanced greenhouse effect.

The Atmosphere

The atmosphere makes life on Earth possible. Without it, or with a changed atmosphere, conditions on the planet would be very different. Not only is it essential for life, it is important to the quality of life: clean, fresh air adds to our sense of well-being.

The report defines the atmosphere as the air environment — from the envelope of gases surrounding the planet to the air inside our homes. It focuses on those aspects of the environment where human activities have a detectable effect. Pressures on the atmosphere are created mainly through the emission of gases and other substances into the air. The report considers these pressures and their impact on the state of the atmosphere, together with our response, at three different scales: global, regional and local.

Most of our atmospheric emissions result from burning fossil fuels for transport, power generation and industrial production. Many industrial, commercial and domestic processes also emit waste gases. Agriculture is a source of emissions, and affects the atmosphere indirectly — clearing vegetation, for example, increases carbon dioxide emissions and decreases its absorption.

The size and growth rate of the human population, the industrial and resource base, economic growth and lifestyles all influence the demand for energy and other resources, and so the level of emissions. For urban areas, the impact of these emissions is affected by the location of the major cities in coastal areas where a natural recirculation of polluted air sometimes occurs.

Global issues

Global issues result from long-lived emissions that become well-mixed through the global atmosphere — for example, the enhanced greenhouse effect and the loss of stratospheric ozone.

The enhanced greenhouse effect

Human activities are substantially increasing the atmospheric concentrations of a range of so-called greenhouse gases. These include carbon dioxide, methane, (tropospheric) ozone, nitrous oxide and chlorofluorocarbons (CFCs). Since pre-industrial times (since about 1750), the concentration of carbon dioxide has increased by more than 30 per cent, and methane by more than 145 per cent.

Greenhouse gases absorb infrared radiation emitted by Earth's surface and so keep the planet warmer than it would otherwise be. Climate models suggest that increases in atmospheric concentrations may lead to global warming because of an enhanced greenhouse effect. The models suggest an increase in the global surface temperature, relative to 1990, of about 2°C by 2100. Many uncertainties remain about the timing, magnitude and regional patterns of climate change. Nevertheless, the balance of evidence suggests that humans have a discernible influence on global climate.

Unless large reductions in emissions occur, the concentrations of most greenhouse gases will continue to rise well into the next century. Models indicate that carbon dioxide levels will more than double unless global emissions are reduced to well below 1990 levels. Australia produces between one and two per cent of global greenhouse emissions, which come mainly from fossil-fuel burning, land-clearing and agriculture.

Initiatives to reduce emissions under the National Greenhouse Response Strategy (NGRS) have achieved limited success. The Greenhouse 21C program includes cooperative agreements with industry and has the potential to bring about reductions in greenhouse gas emissions, though not of the magnitude required to achieve the goals of the NGRS. It is too soon to judge the success of this program.

Ozone depletion

CFCs, together with some other chemicals, have been implicated in another important global phenomenon — the depletion of ozone in parts of the stratosphere, which increases levels of damaging ultraviolet (UV) radiation at the earth's surface.

Losses of stratospheric ozone of between two and four per cent per decade have occurred in mid-latitudes since the 1950s, including over Australia. More dramatic, has been the emergence in the 1980s of a 'hole' in the ozone layer over Antarctica each spring, in which more than 60 per cent of the total ozone is now destroyed over a region covering most of the continent.

Concentrations of CFCs are now levelling off, following the implementation of international controls. Australia has reduced production and use of ozone depleting substances well ahead of international obligations and plans are in place for further reduction. However, because of time lags, ozone depletion will continue to worsen for several years, and UV radiation will increase. Current trends suggest that the ozone layer should begin to recover at the beginning of the next century.

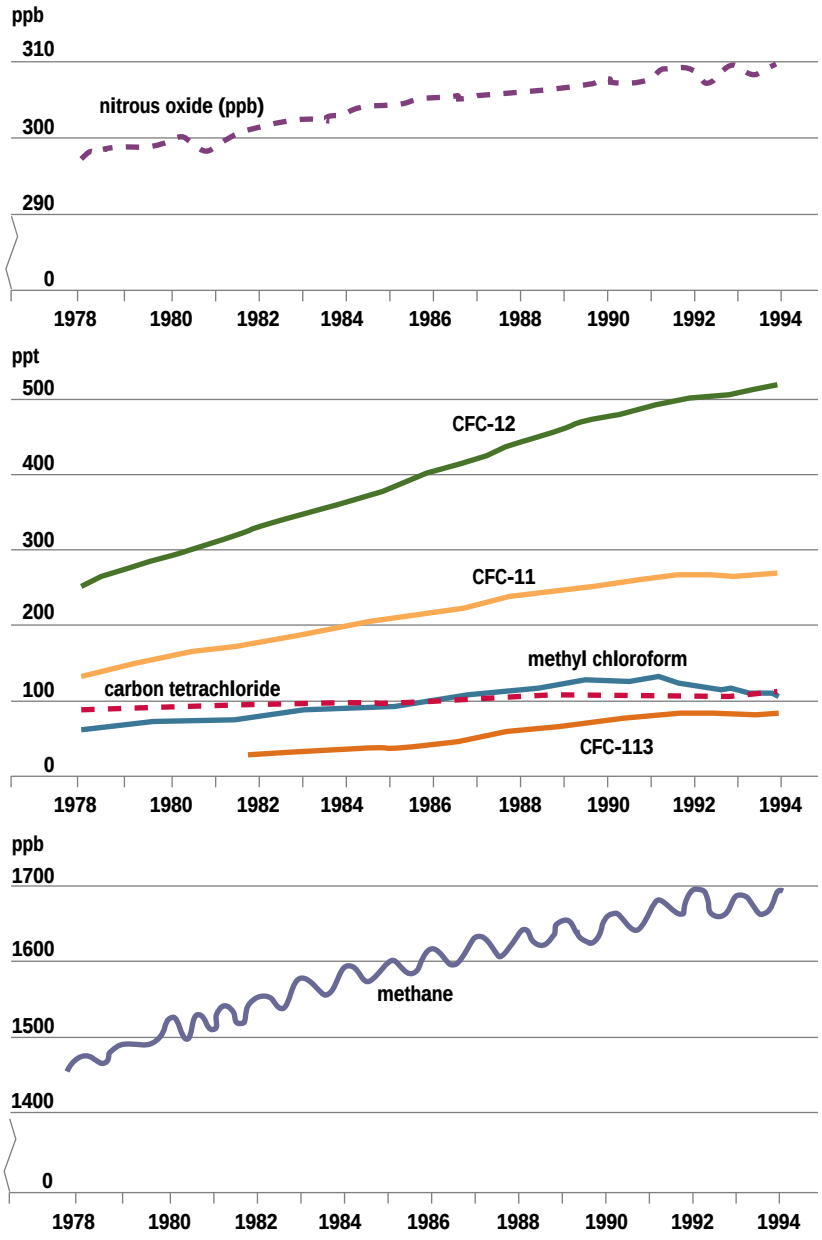
Regional air quality

Pollutants such as vehicle and industrial emissions last long enough to have effects far from their sources — for example, photochemical smog and brown haze.

Air quality is not monitored over 95 per cent of the continent. Certain important point sources of air pollution exist away from the major cities — mainly power stations and metal smelters. The main pollutants from these sources are sulfur dioxide, fluoride and lead. The largest single sources of sulfur dioxide occur in arid areas, where dry deposition of sulfate aerosols takes place downwind of the source.

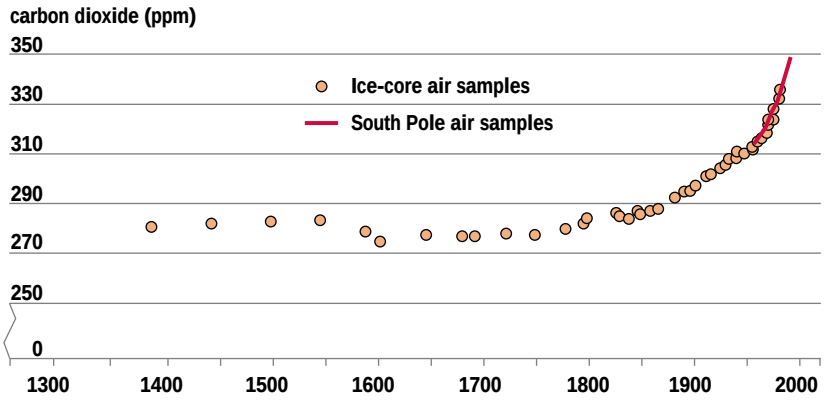
Away from these major sources, air quality is probably good. However, it is difficult to assess trends because of the natural variability of the climate and because changes in demand for metals will affect smelting operations and hence emissions.

Greenhouse gas concentrations at Cape Grim since 1978

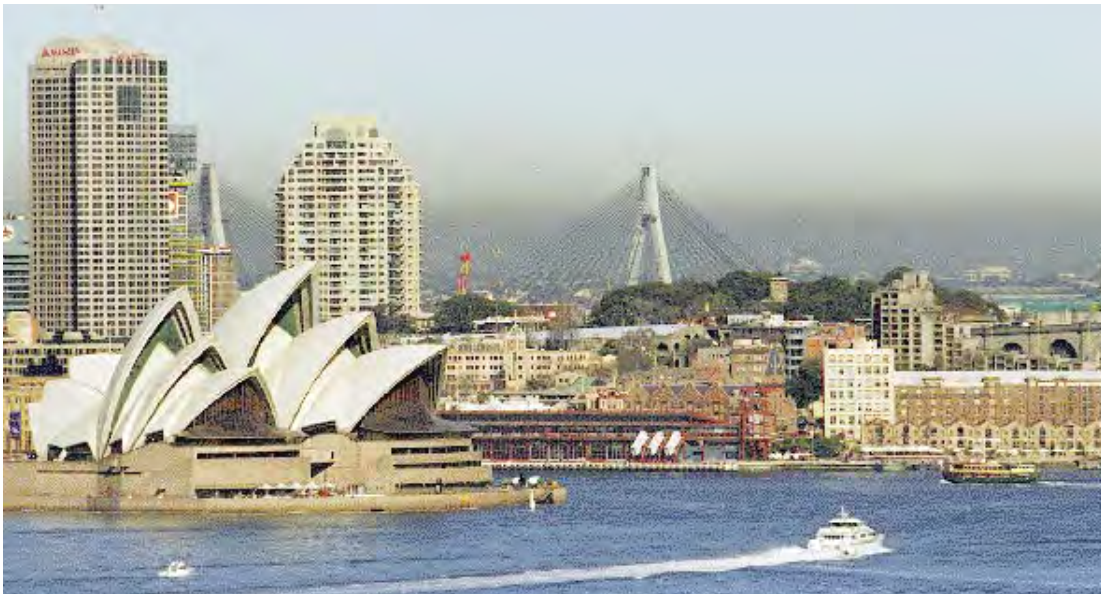


Source: CSIRO and Cape Grim Baseline Air Pollution Station.

Atmospheric carbon dioxide concentrations since 1300 determined from Antarctic ice cores



Source: CSIRO and Australian Antarctic Division.



The airsheds of Sydney, Melbourne and Perth are near capacity for motor vehicle emissions

Urban areas

Motor vehicles are the single most important source of air pollution in cities. In general, the concentrations of common pollutants meet official health guidelines and are low by world standards.

Over the last decade, some aspects of air quality in cities like Sydney and Melbourne have improved. Atmospheric lead levels have declined significantly in recent years due to legislation, pricing measures and voluntary actions by industry. Important initiatives include the mandatory use of catalytic converters and unleaded petrol in motor vehicles manufactured or imported since 1986, the price differential between leaded and unleaded petrol, and a reduction in the lead content of leaded petrol.

Levels of some pollutants, especially carbon monoxide and lead, are likely to fall further. In the short term, a similar trend is expected in smog levels (from emitted nitrogen oxides and hydrocarbons), but this may be countered by increasing vehicle use linked to population growth, urban design and possible deterioration of catalytic converters. In areas of rapid growth, such as south-east Queensland, Perth and western Sydney, vehicle emissions will remain a major concern.

Sulfur dioxide is not a major pollutant in urban areas because of the low sulfur content of Australian fuels and the location of most power stations outside the cities.

Major pollution problems in Australian cities are episodic rather than continuous, being influenced by seasonal and meteorological factors. Depending on local terrain and air flow patterns, pollutants may remain relatively undispersed as air recirculates. Australia's generally sunny climate promotes the formation of ozone and photochemical smog. As a result, air pollution levels in Sydney and Melbourne, particularly for ozone, can approach those in cities such as New York and Tokyo on some days. Perth's air quality is considered to be approaching the limits of its airshed.

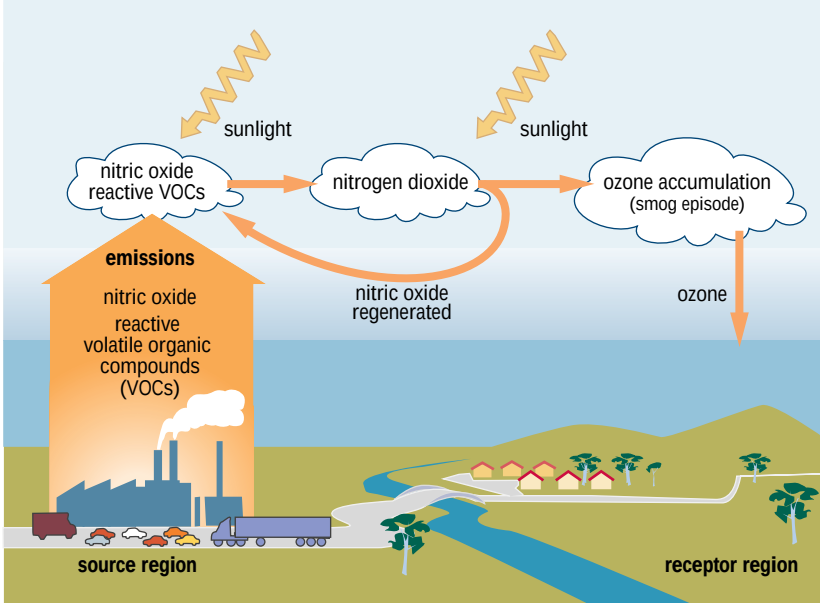
High concentrations of fine particles in the air can reduce visibility, and endanger health. Sources include motor vehicles and woodfires, but pollen, sea salt and silica from soil also contribute to particulate levels. Levels in major Australian cities have generally declined over the past decade or so because of tighter emission controls and bans on backyard burning.

Air toxics emitted by motor vehicles — mainly volatile organic compounds and metallic compounds — are an emerging issue that may need further investigation.

Local air quality

Some pollutants are contained, or rapidly dispersed or inactivated. Odour and smoke arising from traffic, intensive agriculture, wood stoves, backyard incinerators, and even cooking, can be important local issues.

Production of photochemical smog



Indoor pollution

An important local air quality and human health issue is indoor pollution, which can include: house dust mites; tobacco smoke; toxic compounds including insecticides; legionella bacteria in airconditioning systems; and inadequate ventilation and volatile irritants from furnishing and equipment (creating 'sick' buildings).

Management

It is impossible to provide a comprehensive, quantitative assessment of Australia's air quality for national SoE reporting. Issues include:

- lack of a consistent national set of ambient air quality standards
- often inadequate monitoring in major cities
- lack of monitoring outside the major cities
- fragmented and inaccessible data
- inadequate understanding of Australian conditions
- lack of data on the effects of air quality on flora and fauna
- lack of a clear relationship between air quality and human health effects
- inadequate assessment of indoor air quality and health effect

Cape Grim Baseline Air Pollution Station, north-west Tasmania, is part of a global network for monitoring background atmosphere.

Atmosphere: key threats to sustainability

Issue	Detail	Comment
Air quality data	Only 5% of Australia is routinely monitored for air quality. Little is known of the effects of air quality on human health. There are no national air quality standards and no national database.	Implementation of the Inter-Governmental Agreement on the Environment may lead to improvements.
Indoor air quality	Little is known about the long term effects of indoor air quality on human health. However, potential concerns include house dust mites in warm, coastal areas; tobacco smoke; Legionella and asbestos.	Little improvement is expected. Responsibilities for indoor air quality are not clearly assigned. Reductions in ventilation to save energy may worsen indoor air quality.
Stratospheric ozone loss	Stratospheric ozone loss, caused by anthropogenic emissions, has resulted in increased UV-radiation at the surface and poses a threat to human health and ecosystems.	The Antarctic ozone hole has increased in depth and extent since the early 1980s. Ozone levels have also decreased over Australia. Stratospheric ozone levels should begin to recover at the turn of the century as a result of current reductions in global emissions of ozone depleting substances.
Urban Air Quality	There are episodes in most years of extended periods with high levels of ozone and/or particulates in large cities. Major sources include vehicles, domestic burning, control burns and bushfires.	Measures have focused on ozone, generally with success. Current controls are unlikely to be adequate in the future. Lead emissions from vehicles have been reduced. Responses to particulate emissions have been inadequate, and little has been done on air toxics.
Enhanced greenhouse effect	Potential changes in regional climates pose a major threat to sustainability. Australia has a comparatively high level of greenhouse gas emissions per GDP. Australia produces only 1-2% of global emissions.	The balance of evidence suggests that there is a discernible human influence on global climate. Early initiatives to reduce emissions have achieved limited success.
Regional emissions	A small number of remote sources produce 60% of Australian sulfur dioxide emissions. Principal concern is the impact of acid deposition. Potential impacts on ecosystems are not yet comprehensively assessed.	Emissions from some major sources are being reduced through application of environmental protection policies.

Responses to global warming

The prospect of global warming affects virtually every other environmental issue, be it land degradation, air and water quality, biodiversity or marine resources. Evidence is firming for a global warming caused by human-induced increases in so-called greenhouse gases (also known as the enhanced greenhouse effect). In its Second Assessment Report, issued in 1995, the Intergovernmental Panel on Climate Change (IPCC), a United Nations body, concluded that 'the balance of evidence suggests that there is a discernible human influence on global climate'.

Atmospheric concentrations of greenhouse gases have risen considerably since the Industrial Revolution, and concentrations of most, notably carbon dioxide, methane and nitrous oxide, will continue to increase through the next century and beyond, because of the continuing rise in emissions. As a result, interference with the climate system will increase, along with the likelihood of significant adverse impacts.

The global mean temperature has increased by 0.3–0.6°C since the late 19th century. Recent years have been among the warmest since 1860, when instrumental records began. The IPCC says the change is unlikely to be entirely natural in origin. The global sea level has increased by 10–25 cm over the past 100 years and much of this rise could be related to the increase in global temperature. Climate models suggest that global mean temperature will further rise by 1–3.5°C and global sea level by 15–95 cm by 2100.

Knowledge about global warming has increased significantly during the past decade. While scientists are becoming more confident about how climate will change in both hemispheres, projections about the impacts of climate change on a regional scale remain difficult. Higher temperatures could lead to more severe droughts and/or floods in some places, and less severe droughts and/or floods in others. More heavy rainfalls may occur, but not necessarily more severe storms such as tropical cyclones.

Global warming requires global responses. Australia produces only one to two per cent of the total world emissions of greenhouse gases and so our actions alone will have little impact on the issue. Effective global responses will only be achieved through international agreements, linked to effective national emission reduction and other programs. For example, the Joint Implementation initiative will facilitate the transfer of new, more energy-efficient technologies to developing countries where the greatest increases in greenhouse gases are anticipated.

Australia, along with more than 150 other nations, is a signatory to the United Nations Framework Convention on Climate Change, which came into force in March 1994. In essence, developed countries are committed to stabilising greenhouse gas emissions at 1990 levels by the end of the century. The reporting obligations under the convention include a national greenhouse gas inventory, an outline of policy measures taken to limit emissions, and forward projections of emissions to 2000.

To date, Australia has made only limited progress towards stabilising greenhouse gas emissions. Most responses rest on voluntary agreements with industry and the introduction of 'no regrets' measures — that is, measures that have other benefits (or at least no net costs) apart from reducing emissions; many energy-saving measures fit this category. However, several identified 'no-regrets' measures have not yet been implemented. Early in 1995, the Commonwealth government considered, but rejected, the introduction of a small carbon tax on emissions.

In the absence of strong action by all sectors, Australia will not achieve even the more modest emission reduction foreshadowed in the Commonwealth's current policies and programs.

Furthermore, Australia has given little consideration to 'adaptive' responses to the enhanced greenhouse effect. This is important because, even with the efforts to reduce emissions, climate changes are likely.

Land resources

The lives of many Australians, particularly indigenous people and farming families, are closely tied to the land. For the 88 per cent of Australians who live in large towns and cities, and especially those who live in the capital cities, the land is a more distant entity. Nevertheless, responsibility for the stewardship of the land is widely accepted in the Australian community.

We make many different uses of land resources, and often multiple uses of the same patch of land. Australian soils are old and relatively infertile, and rainfall is low; only six per cent of our land is arable, compared with 20 per cent of the United States. The main vegetation is woodland and shrubland.

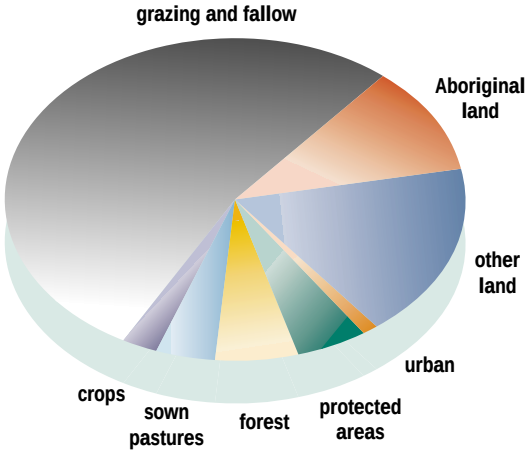
The predominant use is extensive grazing by introduced species, which occurs over 54 per cent of the country. While the area of intensively managed agricultural land (cropping and improved pasture) is proportionally small (six per cent), it is almost twice the total area of the United Kingdom and more than the total area of Japan.

Many pressures affect the state of land resources. General pressures include: population, the failure to allow sufficiently for the poor soil and climate variability, loss of biodiversity, and economic and social pressures. Other, indirect and direct pressures include: agriculture (land clearing, fertiliser use, tillage, changes to water flows, pollution from pesticides and herbicides), pastoralism, forestry, mining, human settlement (urban expansion, tourism and recreation, and transport and utility corridors), and changed management.

Land cover

Although clearing on the scale required to establish Australia's agricultural industries is no longer occurring (it peaked in the two decades after World War II), substantial areas are still being cleared. In some wheat-growing regions, less than 10 per cent of the native vegetation remains. Clearing is an important contributor to environmental problems, especially soil salinity, loss of biodiversity, and net greenhouse gas emissions.

Land use in Australia, 1990



Source: data supplied by ABARE and ABS.

Since the 1980s concern about land degradation, and the decline in native vegetation, has been widespread. As a result, the Commonwealth has established a number of programs such as One Billion Trees and Save the Bush. In addition, some State and Territory governments have established legislative or regulatory controls on clearing. Although the evidence suggests that legislation has been effective in South Australia and Western Australia, there are not enough data to evaluate the effectiveness of controls in other States or Commonwealth programs there.

Rangelands

Rangelands cover about 75 per cent of the country. During the early years of pastoral development stocking rates were generally unsustainable and caused major changes to vegetation and soils. Although only a small part of the rangelands (two per cent) is regarded as severely degraded, a much larger area (15 per cent) is sufficiently affected to require destocking if it is to recover. The conservation value of rangelands varies greatly. Important sites, such as water holes, are the focus of domestic and feral animal activity and are seriously damaged. The Commonwealth, States and non-government organisations are developing a National Strategy for Rangeland Management.

Forests

Before the arrival of Europeans, nine per cent of Australia was covered with forest. Of this area, 40 per cent has been cleared, mostly for agriculture, and that the same area has been affected by logging. Logging can have severe impacts on biodiversity, soil and water. The National Forest Policy Statement, agreed by the Commonwealth and the States, is intended to address the issue of sustainable forest use. Regional Forest Agreements are being established to ensure a comprehensive and adequate reserve system for forests and a report is being prepared on the state of the forests. As an interim measure the Commonwealth has established deferred forest areas with the stated intention of protecting potentially important forests and reserves while comprehensive regional assessments are completed.

Pests and weeds

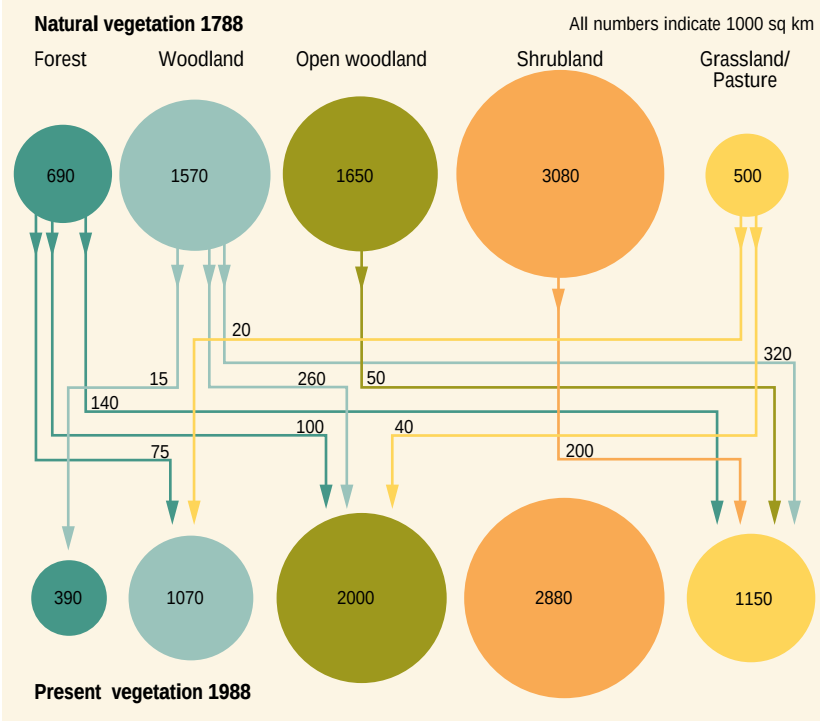
Vertebrate and invertebrate pests cost rural enterprises dearly. Losses occur both directly through consumption and damage to produce, and indirectly through degradation of the resource base. Since European settlement, more than 1900 new vascular plant species have become naturalised — that is, either deliberately introduced or accidentally released. Half of these are now regarded as weeds, and more than 220 have been declared noxious weeds. The major pests and weeds include some native species that have spread and thrive in ecosystems altered by European-style land uses.

Weeds are estimated to cost Australia about $3.3 billion annually. Insects cause annual losses to primary production of about $3.1 billion. A mouse plague in South Australia and Victoria in 1993 cost a total of $65 million, including $55 million in reduced yields. Rabbits are estimated to cost Australia at least $90 million (and possibly up to $60 million) a year in lost production and reduced land values.

Forests: a renewable resource providing timber, water, recreation, conservation and cultural values.

Many Commonwealth government agencies are involved in pest control. The Bureau of Resource Sciences runs a vertebrate pest program, which deals with pest animals in agricultural production. The Australian Nature Conservation Agency has a feral pest program, which addresses the problems of pest management for conservation purposes. Other bodies, established by the Commonwealth, such as the Australian Plague Locust Commission, deal with specific pests.

Land cover change by major vegetation type 1788–1988



Source: AUSLIG, 1990.

Large-scale clearing for agricultural purposes has occurred mostly on the better soils and gentler slopes.

The Landcare movement

The establishment and growth of Australia's Landcare movement in response to the worsening degradation of farmland has attracted international attention.

The 1980s saw increasing efforts in Australia to encourage greater rural community involvement in land conservation, as it became increasingly clear that government legislation and regulation would not control degradation unless individual land users accepted responsibility for their land management practices.

Landcare began as an initiative of the Victorian Government, with the support of the Victorian Farmers Federation. The first Victorian LandCare group was formed at Winjallok in the Wimmera in 1986. In 1988, the National Farmers Federation and the Australian Conservation Foundation proposed to the Commonwealth Government a national land management program which included funding for Landcare groups as a key element.

The Government's Decade of Landcare plan established the National Landcare Program and set a target of 2000 Landcare groups by the year 2000; the target was passed in late 1994. More than 25 000 people are actively involved in Landcare meetings and activities.

Landcare groups contain people who want to work with others to improve the long-term health of the land. Membership is voluntary, the agenda for each group is set by the members and each group operates according to its own plan. The groups give people the capacity, within their own community, to tackle issues that seem too big for individual families.

The major challenge for Landcare is to convince all land users to adopt best management practices to ensure sustainable use of resources. This will involve widespread changes to standard methods of land management.

Expectations for the movement are high, especially when viewed in the context of 200 years of agricultural development and land degradation. The degree of its success could have wide implications for society. The Landcare movement could become a model for other 'care' programs that enlist stakeholder commitment to sustainable resource use.

Soils

Most areas of cropland and improved pasture in Australia are affected by soil degradation. However, within these areas, its impact can vary enormously — even from farm to farm or paddock to paddock. It is impossible to give meaningful estimates of the cost of soil degradation, which occurs in several ways.

- *Soil structure decline:* the structure of many Australian soils is naturally poor or has been damaged by land uses such as tillage and over-grazing. Poor structure increases run-off and erosion and reduces productivity. It is costly to repair.
- *Water logging and salinity:* water tables have risen in parts of Australia as a result of land clearing and irrigation, causing water logging and salinisation. These effects reduce productivity and encourage erosion.
- *Water and wind erosion:* rates of soil erosion, even on the best managed land, may be ten times greater than rates of soil formation. On sloping lands, soil erosion poses a threat to the long-term sustainability of farming.
- *Soil nutrient balance:* Australian soils are infertile, making fertiliser use an essential part of most farming systems. The continental nutrient balance is positive — that is, more nutrients are being added than are being used or lost — but nutrients may be accumulating in fertilised pastures while declining in more naturally fertile soils.
- *Soil acidification:* acidification affects most agricultural land, leading to toxicity, poorer water and nutrient use and so lower yields. Causes include the use of fertilisers and legumes, and natural weathering. Applying lime is an effective remedy, but current rates of application are inadequate.

Food quality

Misuse of agricultural and veterinary chemicals is low in Australia, and the quality of our food compares favourably with other countries. Among the heavy metals, which can be toxic, cadmium exceeds permissible levels in a proportion of some foods including offal and some seafoods.

Sustainability

The question of the sustainability of land use in Australia remains difficult to answer.

Agriculture

Agricultural yields have increased significantly this century, but land degradation could undermine past gains. Inputs of fertilisers and energy into agricultural production have increased, as has our knowledge of better agricultural practices, such as trace element supplements and minimum tillage. Future sustainability will depend upon the efficient use of inputs and continuing to improve our understanding of the land's productive capacity. We also need to know more about the damage to other ecosystems before we can draw firm conclusions about the industry's sustainability.

Forests

The past 200 years have seen the widespread destruction of our forests, through clearing for agriculture and timber harvesting that, in the past, was often unsustainable. The national goal is not to allow our forest estate to be eroded further and to ensure that there is a comprehensive and adequate reserve system to protect at least 15 per cent of each of the pre-1750 forest types for conservation purposes. Stronger and more effective controls are being introduced to cover all uses and values of the remaining forests, such as timber, water catchment and recreation. However, old growth forests continue to be harvested despite several findings that this practice violates sustainability principles.

There is no clear answer to whether our use of the forests is sustainable. In one sense, the answer is that 'it can be'. However, simple and permanent solutions are unlikely to be found; sustainable use must be achieved in the context of a continuing debate by many elements of society, each with different goals and different values.

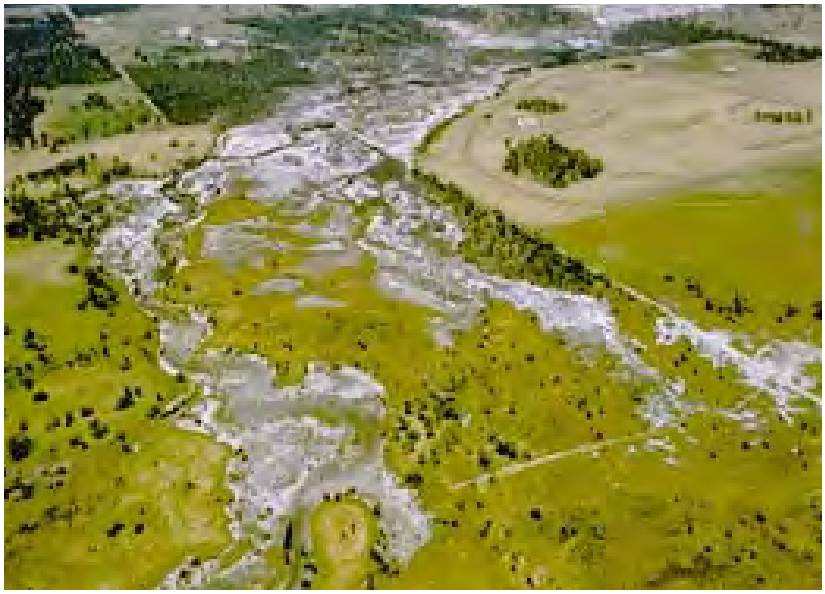
Management

Compared with other developed nations, Australia has only rudimentary information on the condition and productive capacity of its land resources, and the potential hazards associated with their use. This limits our ability to use land in accordance with its capabilities and to monitor trends in its condition.

There are several other major issues concerning the management of land resources:

- Our small population means we have only limited economic and technical resources to manage a huge land area.
- Northern Hemisphere solutions to management problems are often inappropriate, and even counter-productive.
- We have to contend with the impacts of many introduced animals and plants on a previously isolated continent.

The Landcare Program, which is enlisting widespread community support for the sustainable use of land resources, began very successfully and may provide a model of community involvement in environmental management. However, the approach must be extended and sustained, with adequate financial and technical support, if it is to have the necessary impact on land use practices.

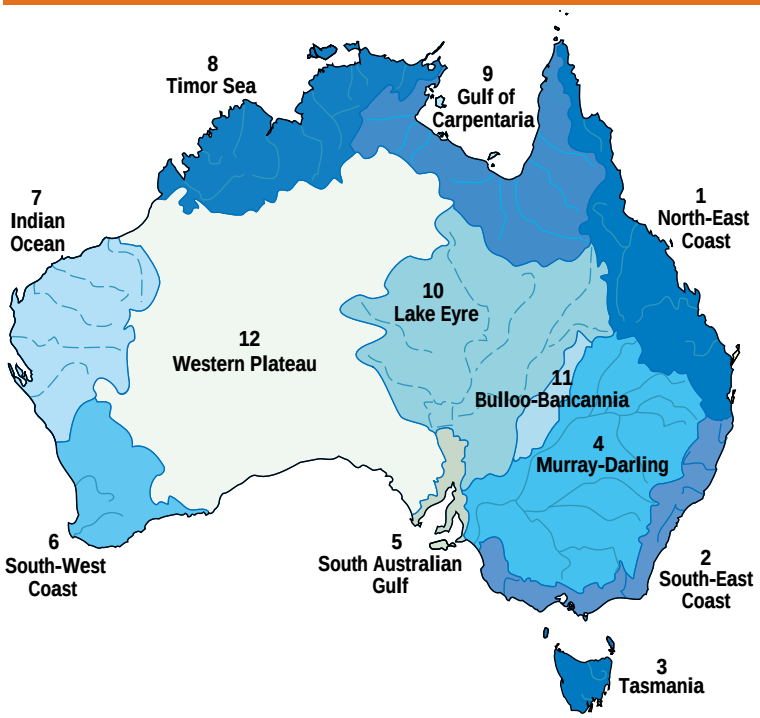


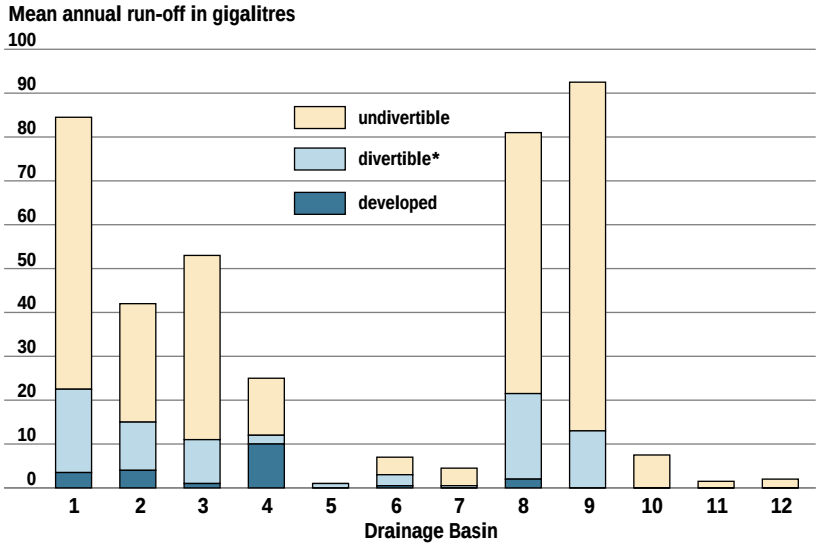
Salt encrustation and soil erosion in the upper Kent River, south-west Western Australia.

Land resources: key threats to sustainability

Issue	Detail	Comment
Land clearing	Land clearing has important implications for land degradation processes, especially salinity, biodiversity loss and green-house gas emissions.	Substantial areas are still being cleared for cropping, grazing and urban development. Programs to retain remnant vegetation and improve on-farm conservation are active, but the rate of replanting is much less than clearing. Deteriorating.
Agriculture	Many areas are subject to slow cumulative threats such as soil acidification, salinity and structural decline.	Substantial damage has been done. Practices are improving in some areas.
Rangelands	Only a small proportion of rangelands is in formal reserves. Some important conservation sites (e.g. waterholes) are threatened because they are the focus of domestic herbivore activity.	There are areas of severely degraded rangelands, but condition and trend vary between regions and are very sensitive to management practices.
Cropping lands	There is particular concern about rates of erosion in marginal cropping areas with shallow soils and variable climate.	Severe degradation will increase if current practices continue. The long term sustainability of cropping on sloping lands is threatened by soil erosion.
Forests	There is inadequate conservation of old growth forests and some other forest types. Logging competes with other uses in native forest areas.	Management methods are improving but monitoring is not yet adequate and primary data are limited.
Data	Compared with other developed nations, Australia has only rudimentary information on the condition and productive capacity of its land resources.	This lack of information limits our ability to use land in accordance with its capabilities and to monitor trends in its condition.

Australia's drainage divisions and water flow





*Note: Divertible run-off represents a proportion that could be used without any regard for economic, social or environmental factors. A responsible level of use may well be substantially less than indicated.

Darling River; large scale abstraction of water has major implications for inland streams.

Inland waters

Australia is the driest of the world's inhabited continents. Of all continents, it has the least river water, the lowest run-off, and the smallest area of permanent wetlands. One-third of the country produces almost no run-off, while two-thirds of the average annual run-off occurs in northern drainage systems.

Australia's rainfall and stream flow are the most variable in the world, and our inland streams are naturally turbid (muddy) and saline. Few permanent, freshwater lakes exist on the mainland; where lakes do occur, they are usually shallow, salt lakes that are dry more often than not.

The largest river system is the Murray–Darling, which drains about one-seventh of the continent. It ranks among the world's biggest in terms of river length and catchment area, but carries much less water than comparable river systems — in less than one day, the Amazon carries the Murray's annual flow.

Over large tracts of inland Australia, (under)groundwater is the only practical source of water for pastoral and mining industries and local communities. The Great Artesian Basin is among the largest groundwater systems in the world.

Since the early days of European settlement, the development of water resources to support the economy and human population has been a priority. Because of our dry and variable climate, Australia stores more water per head of population than any other country in the world. Sydney stores 932 kilolitres of drinking water per person, compared to New York's 250 and London's 18.2. We are now focusing more on the environmental impacts of this development, principally through an initiative of the Council of Australian Governments (COAG) known as the COAG Water Reform Framework.

Drinking water

Water quality in large cities is generally high, but in some rural and remote communities, it is less satisfactory. Problems are usually caused by a combination of micro-organisms, chlorination by-products, taste, odour, algal toxins, iron, manganese, turbidity, salt and 'hardness'. Drinking water in Australia is generally free of industrial pollutants.

Issues

The diversion of water for human purposes has seriously affected the natural environment — wetlands and rivers, in particular, need more water. The environmental stress caused by the over-allocation of water for human use and consumption is greatest along the eastern seaboard and in the Murray–Darling Basin. Some 80 per cent of the divertible or accessible water in the Murray–Darling Basin has now been developed for human use. Elsewhere, the environmental stress is far less severe (and absent in undeveloped areas).

Australia is effectively mining its groundwater, with reserves being used much faster than they are replenished. Groundwater is often very old, with some bores tapping water that entered the ground 1–2 million years ago.

Irrigation uses the most water, accounting for 70 per cent of all the 'developed' resource. Next come the major cities, with most of this use being domestic. Household water use has increased because of increasing populations and rising consumption per head. Industrial water use is not large overall.

A major environmental consequence of both irrigation and land clearing for dryland agriculture is salinisation — the result of rising water tables that bring dissolved salts to surface soils and waters. In some parts of the Murray–Darling Basin, the water table is rising by as much as 0.5 metres a year. In dryland catchments in south-east Australia, the water table has risen by up to 30 metres since the 1880s. About one-third of Victoria's irrigation area has been salinised.

Rice growing in the Murrumbidgee Irrigation Area: expansion in irrigation has been the major factor contributing to the growth in water use in Australia.

Groundwater — a vital but neglected resource

Groundwater is an integral part of the water cycle, and constitutes the largest terrestrial water store — the volume in just the upper one kilometre of the earth's crust is ten times that in all the world's rivers and lakes.

Groundwater is inextricably linked to the surface environment. It sustains many wetlands, allows streams to flow through long dry periods and supports vegetation. It is also affected by disturbances to these surface environments.

Because groundwater lies invisible, beneath the surface, it is poorly understood and often abused. We do not appreciate its vulnerability to over-development and pollution. While there have been substantial improvements in surface water quality in many countries in the past 30 years, groundwater quality has decreased. Many countries face huge costs to clean up groundwater because of waste disposal practices that had little regard for impacts on it.

The use of groundwater has also increased, doubling in the United States since 1950. The same trends in quality and use are occurring in Australia, but we still have time to reverse them.

Management of land and water must take full account of groundwater. A key factor is the much longer time it takes water to flow through underground aquifers than across the surface in streams and rivers. For example, surface water takes only weeks to travel from the Great Dividing Range in Queensland to central Australia after flooding rains; the groundwater of the Great Artesian Basin takes about one million years to travel the same distance.

People living in 60 per cent of Australia are totally dependent on groundwater. In another 20 per cent of the country they use more groundwater than surface water.

The Great Artesian Basin, which underlies one-fifth of the continent at a depth of one to two kilometres, is the lifeblood of much of eastern inland Australia. It is recharged mainly along the western slopes of the Great Dividing Range in New South Wales and Queensland. The uncontrolled flow from bores sunk into the basin has resulted in a serious and unnecessary depletion of its water. A program of bore capping, which is underway, will gradually stem the waste, but at considerable cost.

Pollution is another concern. Because of the timescales involved in replenishing groundwater, once pollution has occurred it is virtually impossible to remove. Unfortunately, the basin recharge areas in New South Wales are also sites of major concern for groundwater contamination. The contaminants listed include total dissolved solids, metals, pesticides and nitrates; the sources are agriculture and mining.

The Murray–Darling Basin initiative

The Murray–Darling Basin initiative is effectively the largest integrated catchment management program in the world, encompassing 1.6 million square kilometres. The initiative promotes and coordinates effective planning and management, for the equitable, efficient and sustainable use of the Basin's land, water and other environmental resources.

The key to the initiative is the 1988 Natural Resources Management Strategy, which provides the philosophical and organisational structure within which the Commonwealth government and the four Basin State governments — New South Wales, Victoria, South Australia and Queensland — can work together with Basin communities to achieve its goals. The strategy's objectives are to:

- maintain or improve water quality through research into the problems affecting catchments
- control and reverse land degradation
- protect and rehabilitate the natural environment
- conserve the cultural heritage

Two funding programs support the initiative: the first covers investigations and education, and the second integrated catchment management. The former funds activities to understand and develop solutions to the Basin's resource management problems. The outcomes are then translated and implemented into practical on-the-ground solutions under the second program. To ensure commitment from the community, at least one-third of the funding for this work must come from the local community.

The Murray–Darling Basin Commission is responsible for administering the initiative. The Commission answers to the Murray–Darling Basin Ministerial Council, comprising the relevant Ministers from the Commonwealth and Basin State governments.

The development of an appropriate structure for managing the grave and worsening degradation of land and water in the Basin has been a long and painful process. The initiative brings this process to maturity — as perhaps best demonstrated by the Council's recent, landmark decision to place an interim limit on further water diversion from the Basin rivers. A final cap on water diversion will be made by 30 June 1997.

The irrigated agricultural industry in Victoria and New South Wales will need major restructuring to deal with the economic and environmental problems salinity causes. Dryland agriculture has increased salt loads and concentrations in many rivers in south-east and south-west Australia. About one-quarter of the cleared land in south-west Western Australia will become salinised over the next few decades, and dryland salinity will also expand in the eastern uplands of Victoria, New South Wales and Queensland.

Sediment from erosion continues to foul rivers, increase the cost of water treatment and reduce the storage capacity of dams and reservoirs. Levels of nutrients, particularly phosphorus, from run-off, erosion and point sources such as sewerage outlets, remain unacceptably high in our rivers, lakes and reservoirs. Levels of pesticides can be expected to increase in both surface water and groundwater.

Consequences

All these problems — sediments, salt, nutrients, pesticides and, in a few cases, trace metals and organic wastes — threaten aquatic environments. High levels of phosphorus, in conjunction with reduced stream flows, have resulted in extensive blooms of toxic blue-green algae, whose frequency may be increasing. The biological impacts of pesticides are largely unknown, but in some cases they cause more damage to aquatic species such as frogs than to the target organisms in crops.

Drainage and the loss of wetlands also threaten aquatic environments. A large proportion of wetlands have been destroyed or seriously disturbed, and the banks of most rivers have been damaged. Introduced species of aquatic plants and animals are another pressure. Exotic fish have established wild populations, often at the expense of native fish and other species. Exotic water weeds have spread in many parts of the country. The most damaging exotic species are the European carp, trout and the giant sensitive plant, *Mimosa pigra*.

As a result of these changes to Australia's inland waters, many species of aquatic animals are endangered, in decline or already extinct. Native fish species have declined in abundance and diversity in most regions of Australia since European settlement. Some 32 species of frogs are reported to be in decline, with only limited data available on many others. The platypus is still found throughout its original range, but frequently in reduced populations.

Management

Australia lacks basic data on water quality and catchment characteristics. Where they do exist, figures are often not collated nationally or are unavailable because of issues of ownership. Information is often of poor quality, incomplete and not comparable between agencies, localities and over time.

Most environmental and water resource organisations give low priority to high-quality

monitoring of phenomena other than flow, and the technical expertise behind many monitoring programs is poor. The Commonwealth-funded National River Health Program, dedicated to developing a nationally consistent methodology for assessing the health of rivers, is a major initiative in this area. It focuses on the use of biological indicators and includes research into environmental flow requirements of Australia's rivers.

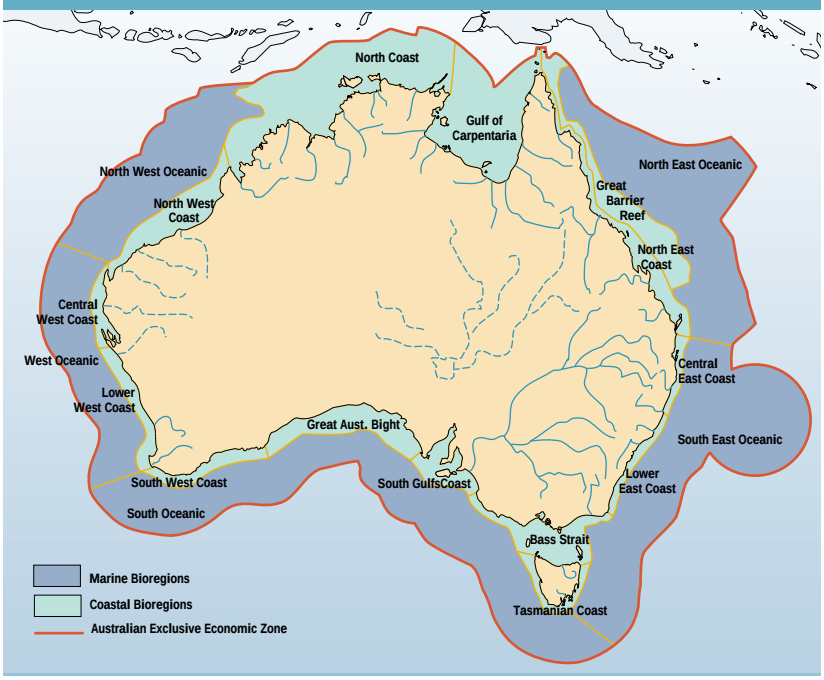
Of the key responses that would improve the condition of Australia's inland waters, the most important is catchment and water management that acknowledges the high natural variability of rainfall and run-off. Catchment management is being implemented over many systems. It is becoming more effective with increasing knowledge and is spreading around the country. The Murray–Darling Basin Commission is the most obvious example of this approach. However, despite these gains, catchment management still lacks the technical support to meet stated goals for water quality.

Wappa Dam, Queensland, before and after the weevil *Cyrtobagus salvinaea* was introduced to control a *Salvinia* sp. infestation.

Inland waters: key threats to sustainability

Issue	Detail	Comment
Dryland salinity	This is increasing in south-west Western Australia and eastern uplands; stream salinity is rising and will continue to worsen.	Much damage has already been done and the situation is deteriorating.
Wetlands	Deterioration of wetlands has been caused by drainage, changes to water regimes and increases in sediment run-off and nutrient inputs.	Wetlands continue to be under threat, and large numbers are already destroyed. The situation is very poor.
Over-allocation of water to consumption	'Droughtproofing' by damming has starved rivers of water, and drastically altered seasonal flow regimes in the most developed areas. Groundwater is being 'mined'	Particularly severe in the south-east of the country. Deteriorating.
Irrigation	The greatest use of water, and the cause of much over-allocation, causing waterlogging and salinisation, and nutrient and pesticide pollution.	A major pressure on inland waters. Infrastructure is ageing and will need replacement. Some land may need to be retired from existing uses. The situation is deteriorating.
Endangered species	Pollution, over-allocation of water, changed flow regimes and exotic and displaced species are all affecting native species.	Many species of aquatic animals are endangered, in decline or extinct. Deteriorating.
Nutrients	Catchment erosion and point-source discharges have contaminated many water bodies so they now produce blue-green algae.	Effects are greatest in the south-east of the country. Trends are unclear but the current situation is poor.
Water weeds	Several vigorous weed species are spreading, particularly *Mimosa pigra* and alligator weed.	Weeds affect the entire country and the situation is generally deteriorating.
Sediments	Although decreasing in some areas, sediments continue to have impacts on biota and water-treatment costs; trends differ between regions.	The outlook is improving in the south-east of the country, but is deteriorating elsewhere.
Monitoring	This is a low priority for most agencies and the technical base is weak. Co-ordination and key indicators, particularly biological, are lacking.	The position is poor and deteriorating.
Data	There are few national compilations from which to estimate state or trend; many basic data do not exist; little interpretation of existing data; poor archiving.	The situation is very poor nationwide. Deteriorating.

Australia's major marine bioregions (ACIUCN) and the Australian Exclusive Economic Zone



The length of the coastline is 69 630 km at 0.1 km scale; area of the Australian Exclusive Economic Zone is about 11.1 million sq km; area of the continental shelf is 2.5 million sq km and width of the continental shelf is 15 to 400 km.

Estuaries and the sea

As an island continent with a long coastline, Australia has many different marine and estuarine environments. These span a wide range of coastal types, climates, geological and biological regions. Most are far away from major population centres and are little affected by human activities. Large stretches of our coastline are among the least-polluted places on earth.

Australia's marine environments extend from its beaches, rocky shores and intertidal reefs to the boundary of its 200-nautical-mile Exclusive Economic Zone (EEZ). They include large areas of the seabed that are important for fishing, oil and gas production and possibly mining, and areas of water that, in places, are biologically highly productive. Generally, however, our marine waters are low in nutrients and therefore productivity. Our estuaries are ecologically important habitats, usually rich in nutrients and with high productivity and biological diversity.

On the whole, our marine and estuarine environments are in good condition. In areas of high population density or intense human activity, however, they are often degraded as a result of urban, agricultural and industrial development and tourist and recreational activities.

Coastal management

Marine management in Australia involves a large number of different management strategies and agreements, arrangements and agencies — international, regional, Commonwealth, State and local government.

Government responsibilities in the coastal zone are fragmented and often overlap, impeding effective management and planning. One Commonwealth document lists 73 Commonwealth programs, 14 strategies, 49 pieces of Commonwealth legislation and 25 treaties that pertain to coastal zone management.

A review of government interests in Jervis Bay, New South Wales, showed that at least 22 acts of Federal Parliament and 29 acts of State Parliament apply directly to the management of the bay's resources.

Almost 60 government reports and inquiries have examined Australia's coastal zone since 1960. The most substantial, the 1993 report of the Resource Assessment Commission, identified the need for an integrated national approach, involving local, State and Commonwealth governments, to address the problems of the coastal zone.

The Commission's inquiry found:

- No single sphere of government can manage the zone
- Issues of national significance and great public concern are involved
- The socio-economic development of the coastal zone is of profound importance to the nation
- Australia has international obligations in the zone that necessitate coordination between the spheres of government

The Commission's main recommendation was that Australian governments should adopt a national coastal action program to manage the resources of the coastal zone. The three spheres of government should implement the program, in consultation with community and industry groups with responsibility for and interest in coastal zone management. The Commission also proposed the enactment of a Commonwealth Coastal Resources Management Act.

In response to the Commission's report, the Commonwealth announced in 1995 a coastal policy that includes funding for the coastal action program, and focuses on:

- increasing support for community and local government participation in coastal management
- increasing the capacity and knowledge of coastal managers
- developing integrated solutions to problems such as urban sprawl and coastal pollution
- conserving ecosystems, cultural and indigenous heritage sites and important landscapes

Nutrient enrichment and sedimentation

The most serious issue affecting Australia's marine and coastal environments is the decline in water quality caused by rising levels of nutrients and sediments. Soil erosion, fertiliser use, intensive animal production, and sewage and other urban and industrial discharges have increased the levels of nutrients (especially phosphorus and nitrogen) and sediments entering many bays and estuaries. Other pollutants include industrial chemicals and pesticides, heavy metals, pathogens (disease-causing micro-organisms) and litter.

Each year, Australia's sewerage systems discharge about 10 000 tonnes of phosphorus and 100 000 tonnes of nitrogen, much of which enters the sea. Yet most nutrients (possibly as much as 85 per cent) come from diffuse catchment sources. Scientists have estimated that, in Queensland, the amounts of sediment, nitrogen and phosphorus entering the sea each year have increased three to fivefold since European settlement. The rivers of Queensland's east coast catchments are estimated to deliver about 14 million tonnes of sediment to estuaries and coastal marine waters annually. Between Palm Beach and Cronulla in Sydney, 200 large stormwater outlets discharge water containing high levels of pollutants such as sediments, bacteria, nutrients, trace metals and organic chemicals.

High nutrient levels promote algal blooms — some toxic. These have increased in frequency, intensity and geographic distribution over the past 30 years. They can degrade ecosystems, reduce the recreational value of waterways, affect human health and destroy aquaculture production.

The Commonwealth is cooperating with State and Territory Governments on issues such as land-based sources of marine pollution, including nutrients and sediment.

Exotic species

Introduced plants and animals are damaging marine and coastal environments. Some introduced species also threaten aquaculture, and pose risks to human health. At least 55 species of fish and invertebrates, plus several seaweeds, have been introduced into Australia, either intentionally for aquaculture, or accidentally in ships' ballast water or encrusted on their hulls. Population eruptions of certain native species — for example, the crown-of-thorns starfish — can also cause problems.

A number of measures have been, or are being, developed in response to these problems, most recently an Australian Ballast Water Management Strategy. A national Centre for Research on Introduced Marine Pests has also been established within CSIRO's Marine Laboratories in Hobart to research early warning tools, better prediction, improved control methods, and more effective assessment of risks and costs.

Fishing

Fishing, both commercial and recreational, imposes heavy pressure on marine species and their habitats.

Loss of seagrass by area and a brief description of the probable causes of the loss

	Location	Area lost (ha)	(%)	Probable cause
1	Cockburn Sound	3 300	79	Elevated nutrients from factories, sewage and abattoirs
2	Princess Royal Harbour	810	66	Elevated nutrients from factories and sewage
2	Oyster Harbour	720	46	Elevated nutrients from farm run-off
3	Gulf St Vincent	7 000	?	Sewage and stormwater discharge; coastal works
4	Westernport Bay	17 800	85	Siltation
5	Birch Point	397	?	
5	Ralphs Bay	430	?	
5	Pittwater	1201	?	
5	Norfolk Bay	2148	?	
6	Botany Bay	257	58	Erosion, coastal works, elevated nutrients and sea urchin grazing
7	Lake Macquarie	700	44	Increased turbidity
7	Clarence River	445	60	Increased turbidity and general decline in water quality
8	Hervey Bay	100 000	?	High turbidity from flooding of the Mary and Burum Rivers
9	Torres Strait	>10 000	?	Floods in 1991–1992
10	West Island–Limmen Bight	18 300	20*	Damage from cyclone Sandy, 1985; much of the area had recovered by 1994.

*Note: This loss represented 20% of the seagrass of the Gulf of Carpentaria

Source: Kirkman, in press

Most major Australian seafood species are now fully exploited. Some, such as the southern bluefin tuna and eastern gemfish, have been overexploited. With the exception of turtles and possibly dugongs, which remain at risk, reptiles (the saltwater crocodile) and mammals (whales and seals) that have been over-hunted in the past are now recovering.

The Great Barrier Reef Marine Park

The Great Barrier Reef is the largest system of coral reefs in the world. It extends over 2500 kilometres and comprises 2900 separate reefs and 940 islands. Its high species diversity includes more than 400 corals, 4000 molluscs, 1500 fish, six turtles, 35 seabirds and 23 sea mammals.

The Reef is one of Australia's best tourist attractions. About two million people visit it and the adjacent coast annually; the number is increasing by 10 per cent a year. The combined value of tourism and fishing on the Reef is estimated at about $1 billion a year.

Pressures

The main pressures on the Reef include: declining water quality in inshore areas due mainly to increased sediments and nutrients; fishing; coral mortality caused by outbreaks of crown-of-thorns starfish; tourism; ballast water from shipping and the threat of oil and chemical spills.

State

The Great Barrier Reef is one of the least-disturbed coral reef systems in the world, and much of it is still in relatively good condition. There is evidence of damage and degradation in some areas, especially some of the inshore reefs. Over the past 30 years, the crown-of-thorns starfish has affected about 17 per cent of reefs, with damage ranging from slight to very severe. The causes of the outbreaks are still unknown.

Response

The Great Barrier Reef was inscribed on the World Heritage List in 1981 and is protected under the Great Barrier Reef Marine Park Act. The park, which covers 344 000 sq kms, is the world's largest protected marine area. It is managed by the Great Barrier Reef Marine Park Authority, with the Queensland Department of the Environment and Heritage responsible for day-to-day administration.

While the agency approach has worked well on a case-by-case basis, better coordination and strategic planning, involving State and local government bodies and industry, is necessary to maintain environmental protection, particularly in relation to coastal development.

The authority recently coordinated the development of a 25-year strategic plan, involving more than 70 user groups, for the Great Barrier Reef World Heritage Area. The authority intends to publish in 1996 a state of the environment report on this area. In addition, the Australian Institute of Marine Science, in conjunction with the Great Barrier Reef Marine Park Authority, has established a comprehensive long term monitoring program for the Reef.

All States and the Commonwealth are revising fisheries legislation to ensure it is directed towards the principles of ecologically sustainable development. Fisheries advisory committees comprising management and industry interests have been established to help develop management plans for individual fisheries.

Mining

Coastal and offshore mining activities can have an impact on marine and estuarine environments. Enterprises include sand and gravel mining, oil and gas exploration and production, coral (limestone) mining, and diamond dredging. Over the past 30 years, oil companies have drilled more than 1100 wells offshore and extracted 2800 million barrels of oil. Their environmental record has been very good, with only about 800 barrels of oil being spilt over this period.

Specific environments

Human activities have caused extensive localised losses of saltmarshes, mangroves and seagrass beds, particularly near major population centres. Australia has the third largest area of mangroves in the world, and the northern mangroves are among the world's most diverse. Our waters also have the greatest diversity of seagrasses, and some of the largest seagrass beds in the world.

Australia also has the largest area of coral reefs. By international standards, our reefs are still in good condition. However, they are now exposed to significant pressures, with those close to population centres showing the most signs of damage.

Marine protected areas are important for conserving specific environments. Although Australia has a very large number of these areas (more than 300 in 1992) most of those in the southern and eastern half of the continent are small and many environments or bioregions are not adequately represented. The Commonwealth is addressing this issue in cooperation with State and Territory governments by developing a national representative system of marine protected areas under the Ocean Rescue 2000 program.

Seafood quality

Environmental conditions affect seafood quality, with the main issue being the accumulation of contaminants in the flesh of seafood species. Our seafood is generally low in contaminants, but exceptions occur in species that accumulate heavy metals, biotoxins, microbes and chemical pollutants. Some survey information is not available for public scrutiny.

Management

An increasing awareness of the pressures on our estuaries and seas has resulted in a range of legislative and management responses to prevent, contain and reduce degradation. For example, licensing point sources of pollution, establishing marine protected areas, oil spill contingency planning, regulation of national and international navigation to reduce maritime accident hazards and

developing fisheries management plans, can all be effective in reducing or managing pressures on the environment.

However, the management of our marine and coastal systems still lacks an integrated and coordinated framework that is built on a set of ecosystem-based goals and environmental performance indicators. Apart from the Great Barrier Reef Marine Park Authority, no agency is responsible for managing the marine environment on such a basis. We do not have the long-term research and monitoring to provide baseline information at a national level, and research and management are yet to be fully integrated as the basis for sustainable use of coastal and marine resources. Such programs as the Commonwealth's State of the Marine Environment Report, National Marine Information System, Coastal Atlas and the Commonwealth Coastal Policy are improving the knowledge base.

Overfishing of southern bluefin tuna during the 1970s and '80s has severely depleted stocks.

Estuaries and the sea: key threats to sustainability

Issue	Detail	Comment
State of seagrasses	Seagrasses have declined in area, particularly the temperate species, and most species are slow to recover after disturbance.	Trends are unclear and will have to be watched closely.
Fisheries: status	Control of catches is needed so that pressure on marine species is kept at tolerable levels.	Stocks of several commercial species have been overfished and it is too early to tell whether recent changes will be effective.
Fisheries: effects	Trawling and dredging can severely affect benthic habitats and populations of non-target species.	Damage has been, and is being, done. It is not known whether changing fisheries regimes will improve the situation.
Integrated eco-system based management objectives	We lack coordination and integration of marine management based on ecologically sustainable multiple-use management objectives for large marine ecosystems.	Our record in this area is poor with no significant improvement.
Effects of nutrients	Many estuaries and bays are affected by excessive inputs of nutrients and/or sediment runoff from the land.	Effects have been serious in some places. While trends are not always clear, this is becoming a major problem.
Effects of coastal development	Increasing development on and near the coast is removing or degrading marine and estuarine habitats, and reducing water quality.	Lack of national and strategic planning is contributing to the continuing deterioration.
State of mangroves	The area of mangrove habitat is declining, particularly in the tropics.	Threats to mangroves continue through unplanned development.
Effects of introduced pests	Mariculture and natural ecosystems are threatened by introduced pests.	Some pests have had major impacts on mariculture. Trends are unclear but will probably get worse.
Coral reefs	Near shore reefs are being degraded by land run-off, tourism and recreation.	This is potentially a serious problem. The current condition is fair, but deterioration is accelerating.
Lack of representative marine protected areas	There is a lack of marine reserves to protect representative samples of marine ecosystems, habitats and species.	A national programme to build a representative system by 2000 is underway.
Lack of knowledge	This affects the ability to make objective decisions, predict the effects of economic development and propose adequate responses.	The knowledge base relating to most areas of the estuarine and marine environments is inadequate.

Australia's world heritage areas

Inscription on the World Heritage List is perhaps the ultimate heritage accolade, signifying that a place has outstanding universal value. The World Heritage Committee decides whether properties are inscribed, acting on advice from the World Conservation Union for natural nominations and from the International Council for Monuments and Sites for cultural nominations.

In becoming a State Party to the 1972 World Heritage Convention, the Commonwealth accepted the obligation to identify, protect, conserve and present World Heritage properties in Australia. Australia now has 11 World Heritage places, all inscribed for their natural values.

Nourlangie Rock in Kakadu National Park provides impressive examples of the rich and complex rock art of the region. These paintings belong to traditions established over many millenia.

Some of these properties have also been inscribed for their cultural values, but so far none has been listed solely for its cultural significance. Revised World Heritage cultural criteria pave the way for the nomination of more cultural sites, particularly Aboriginal places representing living traditions.

Australia's World Heritage properties receive wide community support and are a focus for tourism. Nevertheless, some industry and community groups continue to oppose listings, partly because of misunderstandings about the implications and the uncertainty created by the lack of an indicative list of potential natural and cultural nominations. Disagreements between the Commonwealth and State governments currently prevent some natural areas being nominated.

Australia's World Heritage properties

World Heritage Property	Date inscribed	Values recognised	Management or equivalent plans	Commonwealth-State management arrangements
The Great Barrier Reef, Qld	1981	Natural	In place	Agreed
Willandra Lakes Region, NSW	1981	Natural, Cultural	Being prepared	Agreed
Kakadu National Park, NT		Natural, Cultural	In place	Agreed
— stage 1	1981			
— stage 2	1987			
— stage 3	1992			
Tasmanian Wilderness World Heritage Area		Natural, Cultural	In place	Agreed
— stage 1	1982			
— stages 2, 3	1989			
Lord Howe Island, NSW	1982	Natural	In place	Under negotiation
Central Eastern Rainforest Reserves, NSW & Qld		Natural	Most plans in place	Agreed
— original	1986			
— extensions	1994			
Uluṟu-Kata Tjuṯa National Park, NT		Natural, Cultural	In place	Agreed
— inscribed for natural values	1987			
— inscribed for cultural values	1994			
Wet Tropics World Heritage Area, Qld	1988	Natural	Being prepared	Agreed
Shark Bay, WA	1991	Natural	Being prepared	Being re-negotiated
Fraser Island World Heritage Area, Qld	1992	Natural	In place	Under negotiation
Australian Fossil Mammal Sites (Riversleigh, Qld & Naracoorte, SA)	1994	Natural	In place	Under negotiation

Source: Department of the Environment, Sport and Territories, 1995.

Natural and cultural heritage

Australia's natural and cultural heritage is an integral part of its environment. The state of our heritage is as important as the state of our atmosphere, land, water, seas, plants and animals. Its inclusion adds a new dimension to state of the environment reporting.

Australia's heritage comprises natural and cultural places and objects that have special significance and value to Australians because of the meanings we ascribe to them. They are imbued with human associations, stories, myths and traditions.

Heritage provides the cultural and physical links with the past. It is central to our cultural identity and a source of spiritual well-being. Natural landscapes — with their biological and physical diversity — and cultural landscapes — with their diversity of cultural records and layers of meaning, objects and stories — collectively give us our uniquely Australian 'sense of place'.

Heritage places

Many places remain unprotected for a number of reasons: their heritage values are not recognised; the community is not involved; social values are poorly considered in heritage studies; or resources to identify and conserve places are inadequate.

Tourism has significant effects — both positive and negative — on many natural and cultural places. It can lead to better management, renewed cultural activity and increased understanding, but it can also result in pollution, vandalism and cultural exploitation and debasement.

Urban development, especially in the capital cities, which have the most listed heritage places, creates pressures where, for example, places are demolished or re-used. Neglect is the main threat in areas of low or declining population.

There is no national overview of the physical condition of Australia's heritage places, and no national monitoring system. Historic places and indigenous sites of non-archaeological significance still have no legislative protection in Tasmania and such protection is weak in Western Australia and Queensland.

Heritage objects

Major pressures on heritage objects include poor national coordination, inadequate conservation facilities, loss of context (through removal from their original site, for example) and insufficient documentation. Over the past two decades, the level of technical and other support for biological collections in the major government-funded museums and herbariums has decreased significantly.

We don't know with any accuracy the physical condition of all objects in collections, but many are thought to be deteriorating. No national monitoring system is in place. Indigenous heritage objects in their natural locations receive legislative protection in all States.

Rural landscapes and farm complexes, such as Gulf Station, owned by the National Trust of Victoria, are not well represented in the Register of the National Estate.

Indigenous languages

Loss of traditional languages imposes particular pressure on the heritage of indigenous Australians because these languages provide the most appropriate way of transmitting and maintaining cultural knowledge and the traditions relating to places.

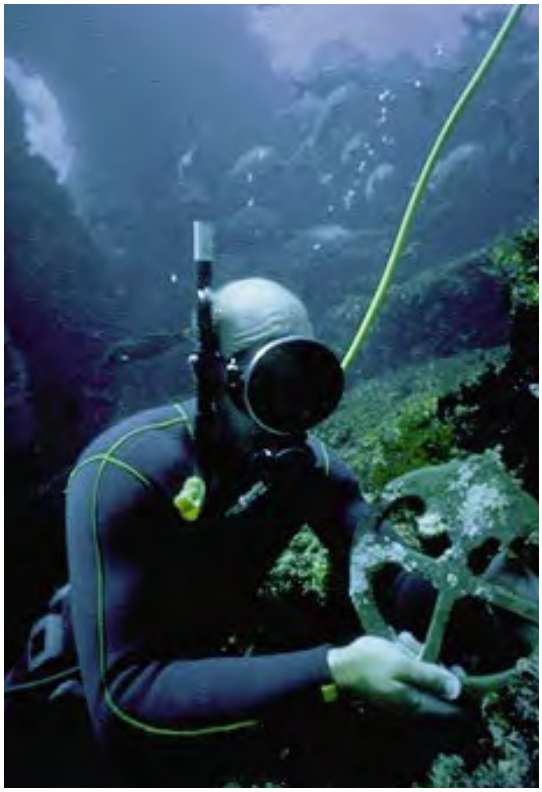
Heritage registers and collections

The size of heritage registers and collections has grown considerably over the last 20 years.

Eleven Australian sites have been inscribed on the World Heritage List, an international register of places of outstanding universal value. The Register of the National Estate (at June 1994) lists 10 772 places, of which seven per cent are Aboriginal and Torres Strait Islander, 16 per cent are natural and the remainder historic.

Although our knowledge about the state of Australia's heritage places has improved substantially (since the early 1980s), major gaps remain for some geographic and subject areas, including places of social value — places which

Australia's major cities contain many significant buildings that are affected by urban redevelopment. The Bow Truss woolstore, Geelong, Victoria, was demolished in 1990 despite professional advice about its heritage value and possible World Heritage significance due to its unique form of construction.



Divers, such as those at the Vergulde Draeck have helped to locate and record many wrecks. However, the growth in recreational diving places pressure on wreck sites through damage and removal of relics.

often seem ordinary but which are so highly valued by the community that threats of their destruction provoke strong protests.

Millions of heritage objects are located in major collecting institutions. Collections of natural objects far outnumber those of cultural items. Some types of objects are poorly represented in both natural and cultural collections. For example, museums contain relatively few objects representing the experience of migrants, working class people and women.

Management

There have been many responses to the state of Australia's heritage and the pressures on it. Community groups, heritage professionals and some corporations and industry groups have actively supported heritage identification and conservation activities. Governments have developed specific policies and implemented major programs to help identify and conserve heritage places and objects, although some programs appear to lack adequate resources. For example, in 1994–95, the National Estate Grants Program, established to assist in identifying, conserving and presenting the National Estate, received 866 applications totalling $28 million for the $4.7 million available.

Legislative protection of heritage places has improved significantly, with governments passing ten major acts covering cultural places since 1987. Programs have been initiated for the national co-ordination of museum and other collections. All State and national museums now employ conservators, and museum policies are changing to redress imbalances in their collections.

Despite numerous positive responses to assist the identification, documentation and conservation of Australia's heritage, it is too early to assess the effectiveness of many recent initiatives. Before we can evaluate these initiatives, we need to agree nationally on which indicators are the most useful to measure the state of our heritage resources.

Major issues

The Australian community realises it has an obligation to protect significant objects and places for future generations. We lack quantifiable national data on the physical state of our heritage, the pressures affecting it, and society's response to

Cultural landscapes

The central Victorian goldfields tell a story much more complex than that of the gold rushes alone. Many people left their mark there — Aborigines, European explorers, squatters, travellers, road-makers, diggers and miners, farmers and foresters. They had impacts and created patterns which can still be identified today in a mosaic of public forests, cleared land, abandoned mine workings, archaeological sites, buildings, roads and other signs of human interaction with the land.

The goldfields are a 'cultural landscape' — part of the environment that has been significantly modified by human activity. A cultural landscape reflects human attitudes, values and interactions with the environment. It has been described as the 'tapestry in which all other artefacts are embedded and which gives them their sense of place'.

Thus the landscape is seen not only as a natural system but as a cultural artefact, consisting of the tangible remains left on the land by cultures past and present. It carries a historical record of memory, symbolism and actual physical vestiges of the past. These meanings are at the heart of community attachment to places and to the development of cultural heritage values.

Much of Australia may be regarded as cultural landscapes because of the traditions and practices of indigenous peoples over thousands of years. Immigrants since European settlement have added further layers of historical evidence and social significance.

Conserving cultural landscapes raises many management issues. The land itself is in constant flux, and the natural cycle of decay and renewal changes the cultural landscape. New land uses, the expansion of townships, the decay of surviving elements and tourist developments can all alter the physical evidence of previous activities as well as adding new layers of meaning.

The adoption of heritage terminology that acknowledges the concept of cultural landscapes, and their inclusion on the World Heritage List and the Register of the National Estate, are important first steps towards establishing benchmarks for how their features are being managed. At present, there are no indicators to assess their state.

these. Without this information, ensuring the sustainable use of our heritage resources is difficult.

The strong links between places, objects and the meanings people give to them are not reflected in current policies and institutional approaches, and no national heritage strategy exists to integrate these elements. Also, heritage considerations do not yet effectively integrate natural and cultural values. The concept of cultural landscapes — parts of the environment that, in being significantly modified by humans, express their attitudes, values and interactions with the environment — provides a powerful mechanism to assist this.

Australia lacks the necessary coordination between and within the three levels of government to ensure effective heritage identification and conservation and the integration of heritage values in early stages of policy and program development.

While we have made progress in many areas of indigenous heritage, indigenous communities still do not have enough say and involvement in identifying, protecting and interpreting their heritage, and in cultural tourism and language maintenance.

All groups in the Australian community need to be involved in heritage matters to ensure their heritage is acknowledged, and to assist in conserving and transmitting it to future generations in good condition.

Heritage week activities, such as the open day at Blundell's Cottage, Canberra, provide an opportunity for the community to enjoy and learn about their heritage.

Natural and cultural heritage: key threats to sustainability

Issue	Detail	Comment
Knowledge about heritage places and objects	While heritage registers include considerable detail about heritage places, there are geographic and thematic gaps. Many collections of heritage objects are inadequately documented and there are major thematic gaps.	Knowledge is improving and the gaps are slowly being filled.
Physical condition of heritage places and objects	Few quantifiable data are available to assess the condition of heritage places and heritage objects. No national monitoring system is in place.	Loss and deterioration of heritage places continues. Deterioration of many collections of heritage objects is likely to continue. Heritage assistance programs are still inadequate, despite improvements.
State of traditional indigenous languages	Some traditional languages are declining, despite language maintenance programs. Few languages are used as primary means of communication.	Many languages have been lost ; others are declining.
Survival of heritage in areas of significant population change	Many places are under significant pressure from urban development, expansion and re-zoning in metropolitan areas and neglect in declining rural areas.	The situation is uncertain due to lack of data, but there are signs of improvement.
Laws to protect heritage places and objects	Indigenous archaeological places are protected in all States and Territories and historic places in all but one. Specific protection of heritage objects is lacking in some States.	Improving.
Community involvement	Cultural groups are not adequately involved in the identification and conservation of their heritage. In particular, indigenous Australians' involvement in policy, decision-making, administration and management of their heritage is still low.	The involvement of indigenous Australians in heritage issues is increasing. Trends in the involvement of other elements of the community in heritage issues are unclear.
Impact of tourism	Increased tourism affects heritage places, heritage objects and cultural values in positive and negative ways, including how they are understood and valued. There are inadequate data to assess impacts of tourism despite major government tourism policies.	The situation is unclear and may be a concern.

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