Chapter 2

Portrait of Australia

Detail from *'Container Train in Landscape'* by Jeffrey Smart, donated to the Victorian Arts Centre by Eva and Marc Besen, 1984.

Prepared by

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under the direction of the
State of the Environment Advisory Council.

Contents

Boxes

An unusual continent

Earth's southern hemisphere consists mainly of water. Only two continents, and some sizeable islands, lie entirely within it and of the two exclusively southern continents, only one — Australia — is permanently inhabited. It is the world's smallest continent, with an area of about 7.6 million sq km. But the nation of Australia, which occupies the entire continent and many outlying islands, is the world's sixth-largest country, and the only one to have responsibility for a whole continent.

Australia is a federal nation divided into six States and two main Territories, each with its own internal government and capital city. The country has 770 local government divisions. It also has seven external territories: Norfolk Island; Christmas Island; Cocos (Keeling) Islands; the Coral Sea Islands Territory; the Territory of Ashmore and Cartier Islands; the Australian Antarctic Territory; and Heard Island and McDonald Islands (see Fig. 2.1). Norfolk Island and Cocos (Keeling) Islands are locally self-governing. The federation of all the States and Territories forms the Commonwealth of Australia, of which Canberra, in the Australian Capital Territory, is the capital. Most environmental responsibilities fall under the shared jurisdictions of local governments, the individual States and Territories, and the Commonwealth Government. The Commonwealth has primary responsibility for international relations, for the sea and seabed outside three nautical miles and for the management of certain areas of national or international significance.

This Land

Give me harsh land to wring music from,
brown hills, and dust, with dead grass
straw to my bricks.

Give me words that are cutting-harsh
as wattle-bird notes in dusty gums
crying at noon.

Give me a harsh land, a land that
swings, like heart and blood,
from heat to mist.

Give me a land that like my heart
scorches its flowers of spring,
then floods upon its summer ardour.

Give me a land where rain is rain
that would beat high heads low.
Where wind howls at the windows

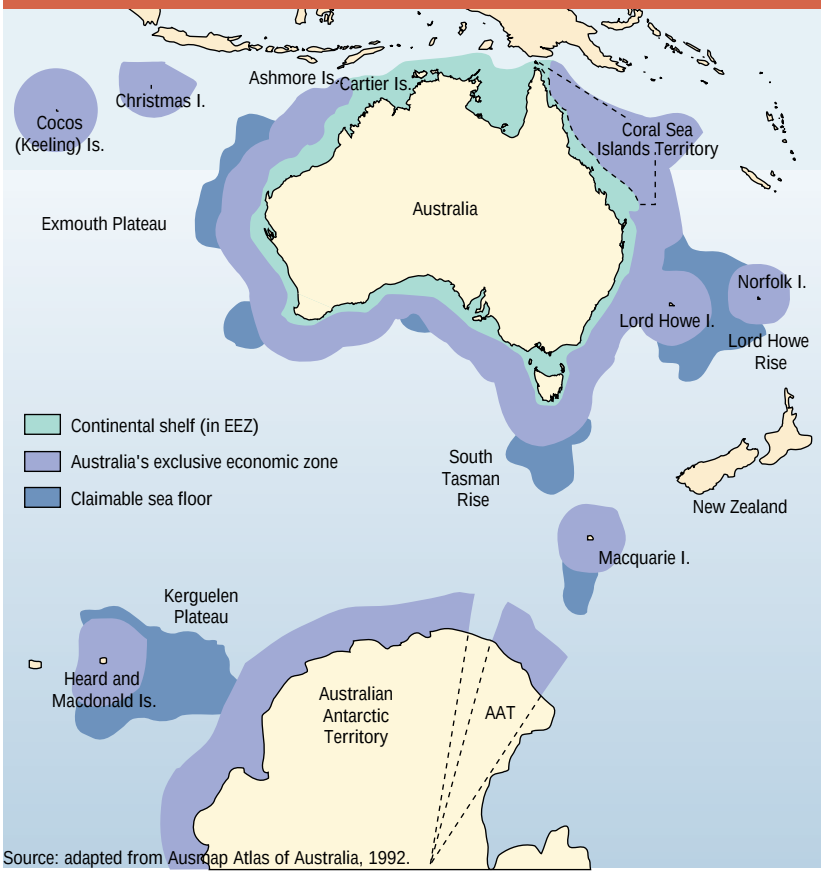
and patters dust on tin roofs
while it hides the summer sun
in a mud-red shirt.

Give my words sun and rain,
desert and heat and mist,
spring flowers, and dead grass,
blue sea and dusty sky,

song-birds and harsh cries,
strength and austerity
that this land has.

By Ian Mudie (1911–1976) In *The New Oxford Book of Australian Verse.* (Chosen by Les A Murray. Oxford University Press, Melbourne 1987).

Figure 2.1 Australia and its external territories



Source: adapted from Ausmap Atlas of Australia, 1992.

Because Australia has no land boundaries, we do not suffer any great problem of pollution coming from other countries via the air or rivers. Of course, some general air- or water-borne contaminants from around the globe inevitably enter Australia and emissions of greenhouse gases and ozone-depleting substances have an impact. Our nearest neighbour is Papua New Guinea, about 130 km from the tip of the mainland, but only a few kilometres from the northernmost islands of the Torres Strait. The issue of transboundary pollution is starting to arise in terms of the effect of the discharge of rivers carrying waste from mining operations within Papua New Guinea into the Torres Strait. In theory, types of air pollution from Indonesia could also reach our northern shores. A major quarantine concern is the potential for organisms to be introduced from overseas.

Although we have no land boundaries, Australia does have marine jurisdictional boundaries with five neighbours — Indonesia, Papua New Guinea, New Zealand, New Caledonia and Solomon Islands — and the international waters beyond us are shared with and used by many countries.

The southern hemisphere remains, in general, markedly less affected by human activities than the northern. Australia lies in relatively unpolluted air and sea. But its position ensures that it is affected

by certain natural features of the southern hemisphere ocean and atmosphere that cause great climate variability. In particular, Australia lies near the centre of action of the so-called El Niño–Southern Oscillation (ENSO), described in the box on page 2-8.

The imprint of the ENSO phenomenon can be detected in the continuous records of nearly all climatic variables in Australia, but it has its greatest impact on rainfall and air temperature. The most pronounced variability in the Australian region occurs over the eastern two-thirds of the continent, where ENSO accounts for 30–40 per cent of rainfall variability, which is such a feature of our continent.

As well as the ENSO, changes in sea-surface temperature in the Indian Ocean contribute to climatic variability through their effect on the passage of north-west rain-bearing cloud bands over the continent. In some seasons, such cloud bands can bring increased winter rainfall to southern and western parts.

The land

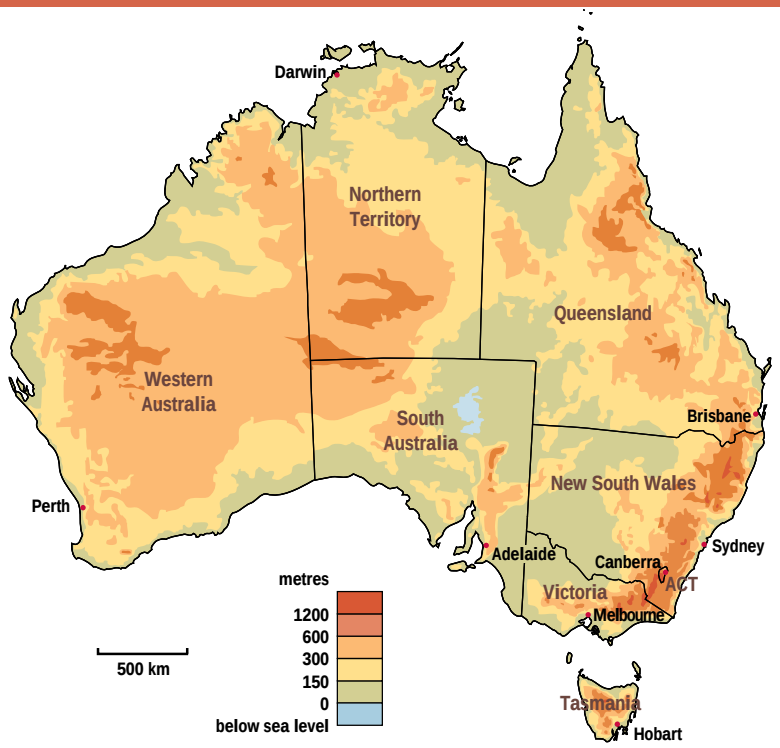
Mainland Australia (see Fig. 2.2) extends some 3180 km from the tip of Cape York in the tropical north to South Point on Wilson's Promontory in temperate Victoria. The southern tip of Tasmania is a further 500 km south. From east to west Australia stretches about 4000 km. In area, the country is about 32 times larger than the United Kingdom, more than 20 times larger than Japan, two-and-a-half times larger than Indonesia, and nearly as large as the United States without Alaska. However, in terms of population, it is much smaller than any of these countries.

Along the continent's eastern margin lies the Great Escarpment. In part coincident with this, but often up to 300 km further inland, is the Great Dividing Range. Both these formations are 'great' in length rather than height. Their highest points rarely exceed 1600 metres, and their features are interrupted in places by river valleys, such as those of the Fitzroy River near Rockhampton and the Hunter River near Newcastle. The highest parts of the uplands occur in the continent's south-east, where a small truly alpine area, snow-covered for more than half the year, includes Australia's highest mountain, Mt Kosciusko (2228 m above sea level). Australia's lowest temperature of –23° C was recorded at Charlotte Pass, New South Wales, in this alpine region on 29 June 1994.

West of the eastern uplands are the lowlands of the Great Artesian Basin and further west, the Western Plateau with emergent ranges, such as the MacDonnell, Hamersley, Stirling and Flinders Ranges. The large, flat, limestone Nullarbor Plain (the name means no trees) is a distinctive feature. This arid area was once the bottom of a shallow sea during the Tertiary period (65 to 20 million years ago).

The Murray–Darling system forms the largest drainage basin, but it has a small volume of flow (0.15 ML/sec on average) in comparison with drainage basins in other parts of the world.

Figure 2.2 Australia's continental elevation, capital cities and States

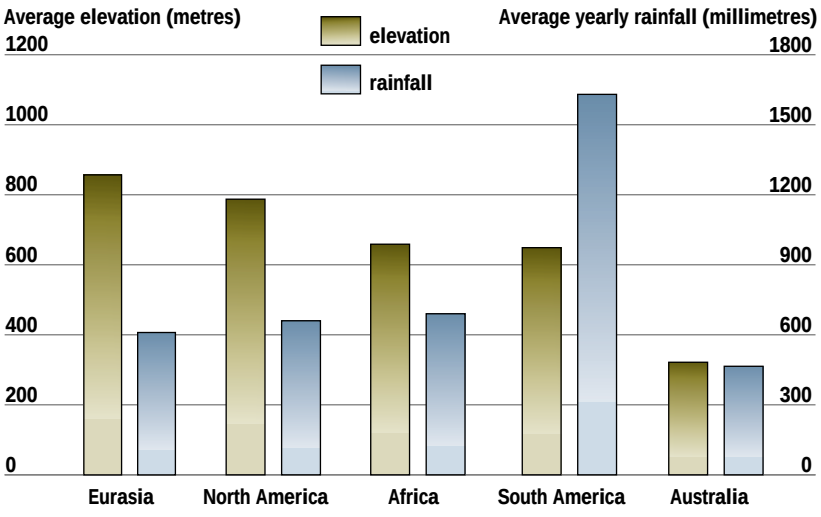


For example, the Mississippi River has an average annual flow of 17 ML/sec and the Amazon River has 180 ML/sec. The system drains rainfall from part of Queensland, a large part of New South Wales, the Australian Capital Territory and much of Victoria. It flows into the sea on the eastern side of South Australia. The Murray is about 2500 km long, while the Darling and Upper Darling Rivers together total about 2000 km.

World's lowest continent

Australia has the lowest average elevation and also the lowest absolute relief (the difference between highest and lowest points) of any continent, partly as a result of its long period of geological stability (see Fig. 2.3).

Figure 2.3 Average elevation and rainfall of the world's inhabited continents



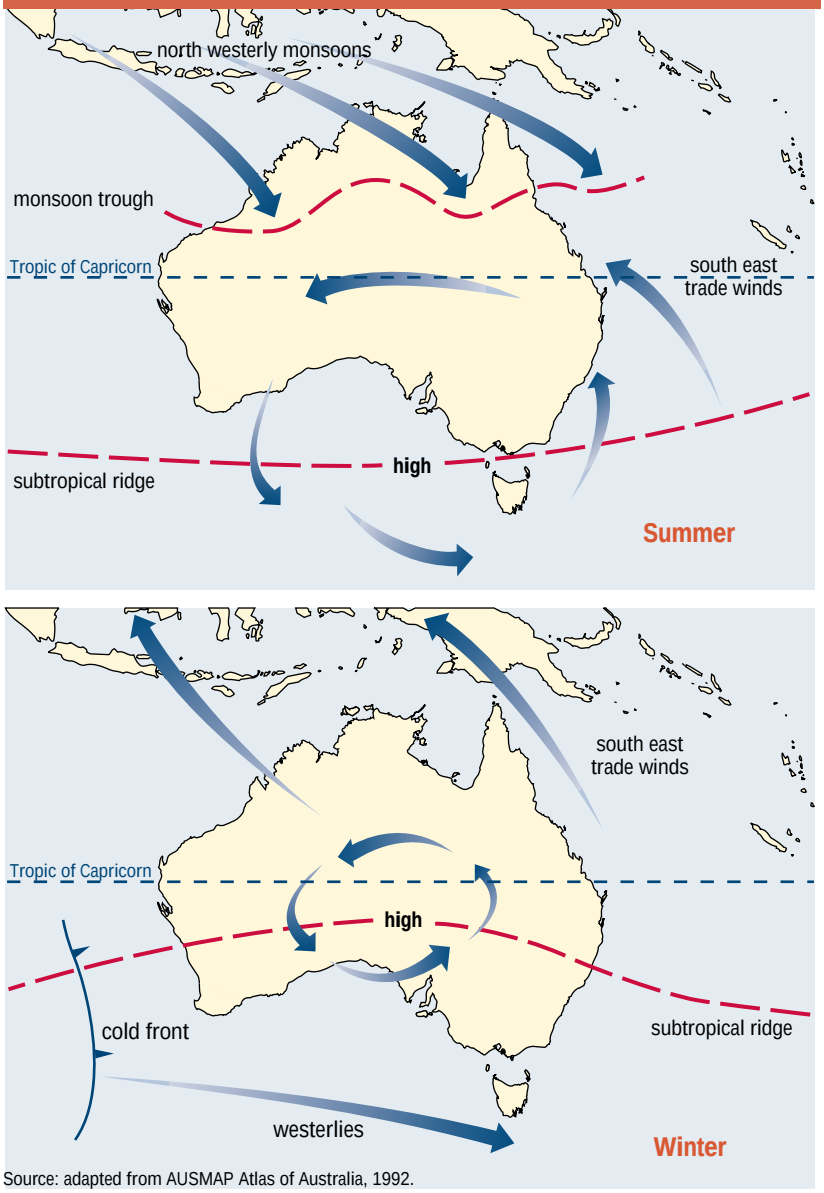
Source: AAS, *Environmental Science*, 1994 and ABS, *Yearbook Australia*, 1995.

Its few mountain ranges are exceedingly low by world standards, and most of the country is a broad flat platform, broken by low hills and basins in a few places. The eastern uplands provide an important feature, ensuring a fairly reliable rainfall to the eastern seaboard. Partly because it has no high mountains, Australia is also the only continent with no permanent year-round snow.

Stable geology

Australia is the only continent without a geologically active volcano, although both western Victoria and northern Queensland have experienced major volcanic events in the last 20 000 years. The country does not have great rift systems or large permanent lakes. Large areas have been stable for very long periods of time and in these places the surface features have changed relatively little. Much of western and north-western Australia and large parts of the eastern areas have been stable dry land for 400 million years, and most of the continent has been extensively weathered for at least 60 million years, with surface features and rocks greatly eroded. While we have some of the oldest rocks yet recorded on the planet, the great antiquity of our landscapes is not so well appreciated.

Figure 2.4 Atmospheric circulation over Australia



Source: adapted from AUSMAP Atlas of Australia, 1992.

Lowest rainfall of any inhabited continent

Australia's latitude ranges from about 10° S to about 43° S. This puts much of it in a zone of high atmospheric pressure and therefore low rainfall (see Fig. 2.4), which is exacerbated by the absence of high mountains. Indeed, it is the driest inhabited continent (Antarctica is the absolute driest, partly because it sits in the polar high-pressure region).

More than one-third of Australia is classified as arid, which means it receives an average annual rainfall of less than 250 millimetres. Another third is semi-arid, with an annual average between 250 and 500 mm (see Fig. 2.5). By comparison, the country's cities receive much higher rainfalls and thus are not representative of most of the continent (see Table 2.1). However, definitions of aridity based on rainfall take little account of differences in evaporation rate. Perhaps a better indicator of Australia's dryness is the minimum rainfall necessary for successful crop-growing without irrigation in the different latitudes. In the far south of Australia, rain-fed crops need about 250 mm of rain per year; in most of New South Wales they need at least 375 mm a year; this rises to 500 mm in northern New South Wales and south-eastern Queensland, and to 750 mm a year in the far north of the country. The important point is that areas in the north can receive much higher rainfalls than those in the south and still be arid.

Despite its aridity, Australia has few areas of true desert — defined either as areas of no perennial plant growth or as places receiving less than 100 mm annual average rainfall. (The region around Lake Eyre in South Australia receives the lowest rainfall in the country with an annual average of about 100 mm.) Environmental conditions in the arid zone are surprisingly variable, partly because rain, when it does come, can be very localised and also because water may accumulate in natural features, which can serve as relatively lush refuges during dry times.

Diverse climate

Australia's geographic location and its size mean that it experiences a wide range of climate zones: temperate climates in coastal Tasmania and the southern parts of the mainland; Mediterranean in the south-west and south-central areas; tropical climates in the north; subtropical along the warm east coast; and a small region of alpine climate occurring in the south-east of the mainland and in central Tasmania (see Fig. 2.5).

Much of the continent lies in the earth's desert zones, which are between about 20° and 35° north and south of the equator. This area experiences high atmospheric pressure, formed from descending air that has arisen in the tropics. High-pressure cells travel across the country from west to east. In the

cooler half of the year (May to October) the high-pressure systems pass right across the continent — often remaining stationary for several days. Northern Australia falls under the influence of mild, dry south-east trade winds, while southern areas experience cooler, moist westerly flows. In the warmer half of the year (November to April), the highs become centred well to the south of the continent. Easterly winds predominate and most of southern Australia experiences fine warm weather; but great heat — with daytime temperatures often greater than 40° C — can build up throughout much of the inland.

More than one-third of Australia lies in the tropics (see Fig. 2.4) where cyclones are a feature of summer. These bring heavy rains and strong winds and their effects can reach much further south. They are unpredictable in their frequency and likely trajectory, so areas where rainfall is mainly cyclone-derived — such as much of the inland north — have an inherently unpredictable climate pattern. Cyclones also cause natural disturbance in the coastal zones, where they are at their strongest. The northern Queensland rainforest, for example, relies on the passage of cyclones to uproot trees and provide gaps in the dense canopy for saplings to grow. The human and economic cost of cyclones is very real, the worst in Australia's recorded history being the devastation of Darwin by Cyclone Tracy over Christmas 1974.

Most annual field crops require a three- to six-month growing season — that is, a time when rainfall, temperature and light are all within the tolerable range for the particular species being grown. In many parts of Australia the growing season is determined by lack of rainfall, or limiting high temperatures; but in southern upland and inland Australia, winter frosts limit the choice of crops and may check the growth and development of adapted crops.

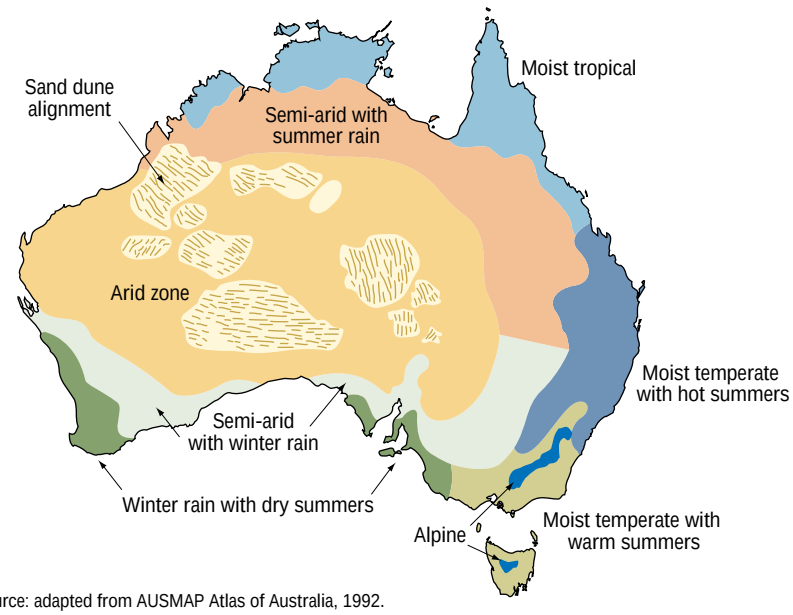
The extremes of climate over much of the continent limit human settlement and cause social, economic and planning problems.

Table 2.1 Rainfall in our major cities

	Average annual rainfall (mm)	Number of rain days/yr
Sydney	1214	148
Melbourne	655	143
Brisbane	1151	123
Adelaide	578	119
Perth	873	119
Hobart	628	160
Darwin	1661	108
Canberra	626	109
Alice Springs	285	44
Cairns	2032	155

Source: Bureau of Meteorology, Climatic Averages of Australia, 1988.

Figure 2.5 Australia's climatic zones

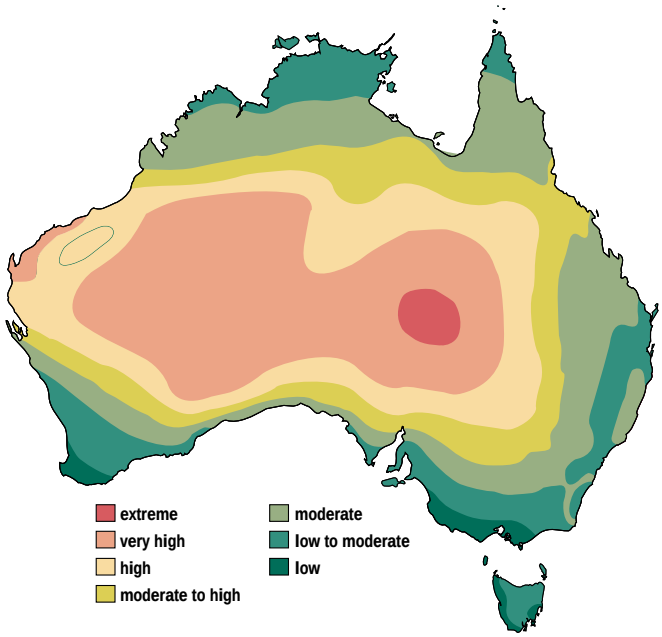


Source: adapted from AUSMAP Atlas of Australia, 1992.

Variable climate and rainfall

Combining the range of annual temperature and the degree of variability in annual rainfall gives an index of climatic variability for different parts of the country. The result is shown in Fig. 2.6. Clearly the central zone varies the most, while the whole eastern coast, including Tasmania, and the south-west tip of the continent show reasonably stable climate patterns. Not surprisingly, these areas have been most heavily settled by European and other recent immigrants in the last 200 years. They are also the areas with the most intensive agriculture and, increasingly, the greatest conflicts over land use.

Figure 2.6 Australia's climatic variability

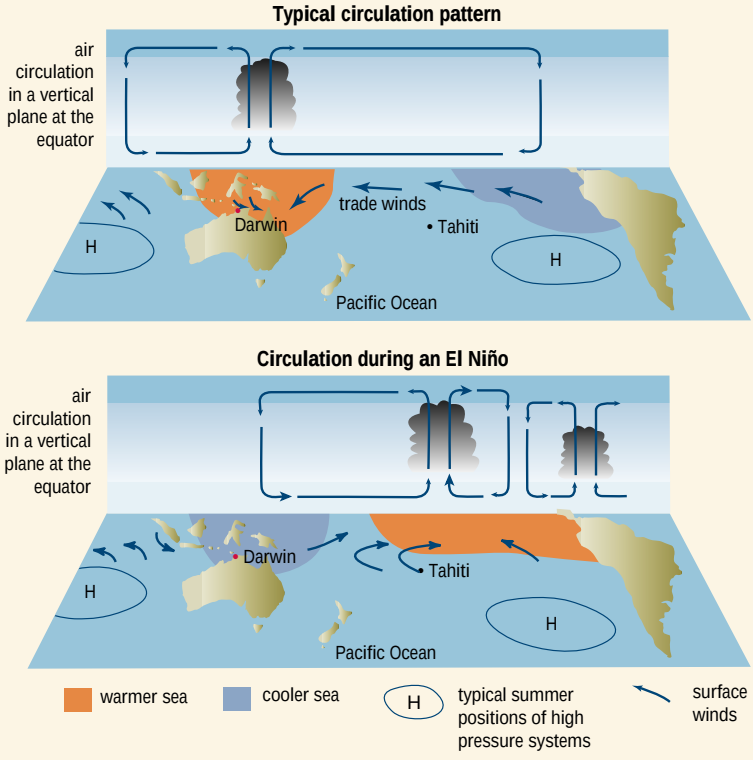


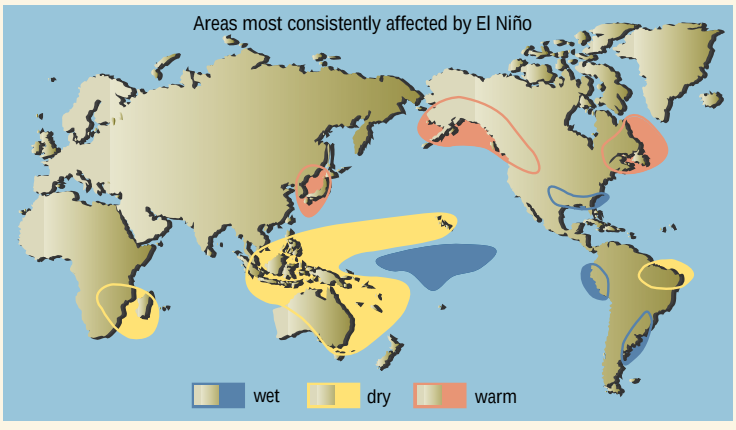
Source: ABS, *Yearbook Australia*, 1988.

El Niño–Southern Oscillation

South American fishermen gave the name El Niño to the sudden change in sea-water temperature associated with the disappearance of anchovies that occurred irregularly every few years off the Pacific Coast of South America near Christmas time. The Southern Oscillation, which occurs irregularly about every 2–7 years, is a meteorological term that refers to a large disturbance in the atmospheric circulation over Australia and the eastern Pacific. It is a measurable see-sawing change in average atmospheric pressure between the mid Pacific and northern Australia (measured at Tahiti and Darwin respectively).

For most of the time, pressure remains high over the mid-Pacific, and lower over Australia and the Indian Ocean. However, every few years the surface water in the central and eastern Pacific undergoes a remarkable warming, which leads to substantial changes in the atmospheric circulation throughout the entire Asia–Pacific region. The atmospheric pressure situation reverses, with persistent below-average pressure in the mid-Pacific and higher pressure over eastern Australia. Much of Australia — particularly the eastern part — then experiences a drought. The generic term El Niño–Southern Oscillation (ENSO) refers to the whole suite of events. Some ENSO impacts are also felt in the northern hemisphere.





Tremendous fluctuations in annual rainfall occur commonly throughout the country. Sequences of years with high rainfall, and consequent lush plant growth, can give a false picture. The variability is associated with the El Niño–Southern Oscillation, especially for the eastern half of the continent. It occurs across all time scales — within a year, between years and across decades and centuries. In some places, where total rainfall is cyclone-dependent, a large proportion of the annual average can fall within days, with little or none for the rest of the year. Hence, averages are misleading. The town of Alice Springs in the centre of the continent has an annual average rainfall of 270 mm, but the actual quantity that falls in a year has varied from 60 mm to 900 mm since records began.

Other areas of the country, such as south-west Western Australia, have strongly seasonal rainfall patterns, with long, hot and dry summers and mild wet winters. Variability, seasonality and evaporation rates influence agricultural production and the location of various agricultural enterprises. Many cities require large water storages to last during the inevitable, but unpredictable, dry spells.

In eastern Australia, the climatic fluctuations between years are partly accounted for by the El Niño effect.

The natural variability of Australia's climate affects many aspects of the country's environment — from the fauna and flora to the patterns of settlement and the water supply. It also tends to exacerbate many of the human impacts on the natural environment.

Generally unproductive soils

Australian soils are among the most nutrient-poor in the world — mainly because many components and minerals have leached out during the land's long exposure to weathering. The continent has been geologically stable for a long time; with little glaciation, mountain-building or seismic activity and scarce formation of new soil during the past few million years.

Much of the interior is covered with sandy soils that cannot hold water for long, even when it does rain. Other soils are naturally salty, low in nutrients and organic matter and, in some places, extremely stony. Unstable cracking clay soils, which swell when wet and shrink when dry, cover about 10 per cent of the country, creating problems for agriculture and building.

Some soils lack trace elements such as cobalt or copper. Some plants, especially native ones, may be able to grow in these soils, but grasses grown to feed sheep or cattle will become deficient in the element and die. Over many parts of the country plant growth was always sparse, but native plants helped enrich and retain the soil. The reduction in land vegetation cover has undoubtedly increased soil erosion in many areas.

The little volcanic activity that has occurred during the last 10 million years has been responsible for some areas of good soil. However, less than 10 per cent of the country is thought to have reasonably

productive soils — that is, soils that can sustain intensive agriculture or dense vegetation. Many areas of otherwise favourable soil occur in regions that are too dry for non-irrigated agricultural use.

World's most fire-prone continent

Large fires can occur somewhere in Australia at any time of the year (see Fig. 2.7). This is not just because of the generally hot and dry climate. It is also because of the climate variability: wet periods allow vegetation to build up as fuel for a fire that can take hold after a dry period. The characteristics of much of the natural vegetation are also important. The flammability of eucalyptus oil and the dry leaves of many plants encourage the spread of fire. In some natural communities, fire is important as a way of recycling nutrients, a task performed by soil organisms in wetter environments. Much of the native vegetation is adapted to fire — indeed many species, including trees such as the mountain ash (*Eucalyptus regnans)*, that live in normally 'wet' forests, need fire before seeds will set or germinate. This suggests that fire has long been an important feature of much of the country. As well, the fire-lighting practices of the Aboriginal people may have created more grassy areas, which burn more easily.

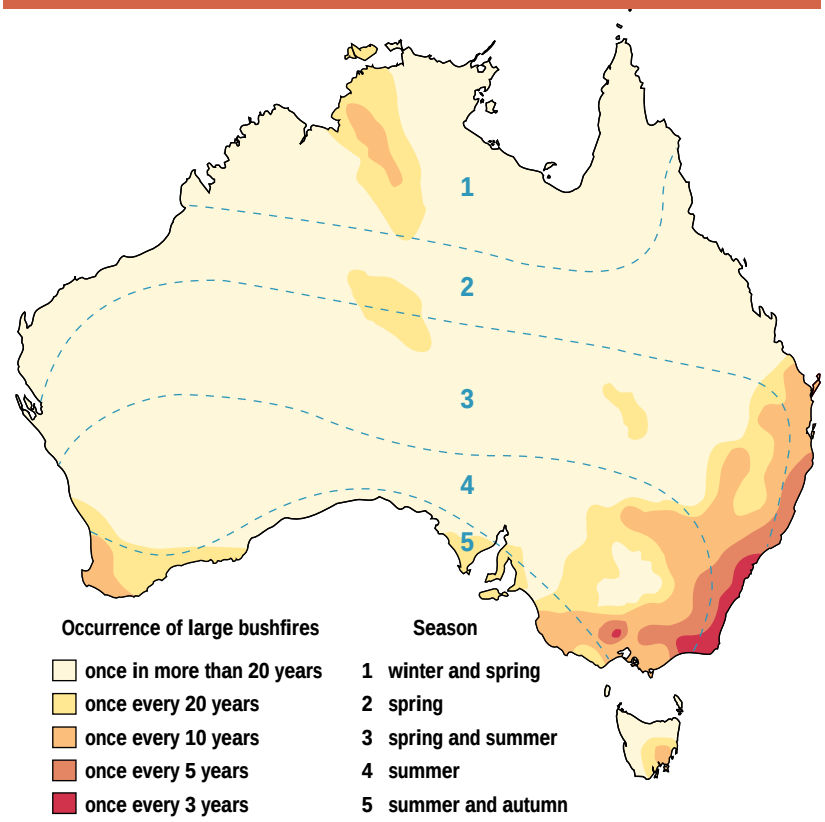
Few rivers, low run-off

After Antarctica, Australia has the fewest rivers and the least run-off of any continent. Its low rainfall means that, for a land area of its size, Australia has few sizeable rivers, and few accumulations of fresh water. Many of the rivers we do have are neither fast-flowing (because most of the land is flat) nor regular (because of the rainfall variability). In most parts of the world, run-off usually drains into creeks and rivers that eventually enter the sea. But in Australia, many rivers drain inland, where all the water eventually evaporates.

Most inland lakes are dry for long periods and many are brackish or salty. Only a minute proportion of the continent is permanently covered with fresh water, and recent human activity is increasing salinity in major waterways such as the Murray–Darling system.

Australia has a very low total run-off per unit area of catchment compared with other large landmasses, and a much more variable one. Nearly one-third of the country, the western plateau, has no significant run-off at all. By contrast, Tasmania, which accounts for just 0.8 per cent of the land area, provides 13 per cent of the run-off because of its high rainfall and low rates of evaporation. So, the fresh water that is available is not evenly distributed.

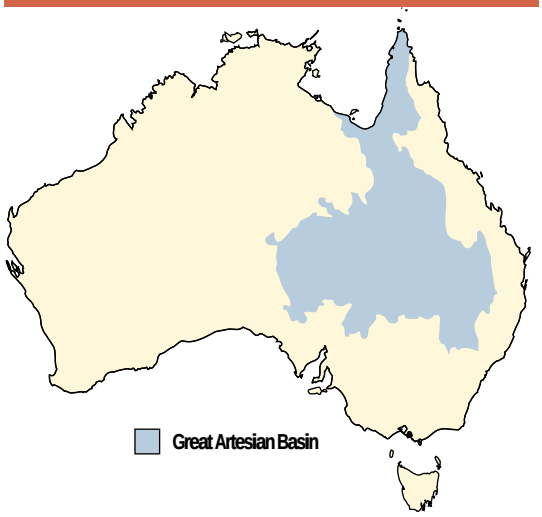
Fig 2.7 Frequency of bushfires



Source: adapted from AUSMAP Atlas of Australia, 1992.

Burnt forest in southern Australia; large fires occur in different parts of Australia throughout the year.

Figure 2.8 The Great Artesian Basin



Source: Australian Water Resources Council.

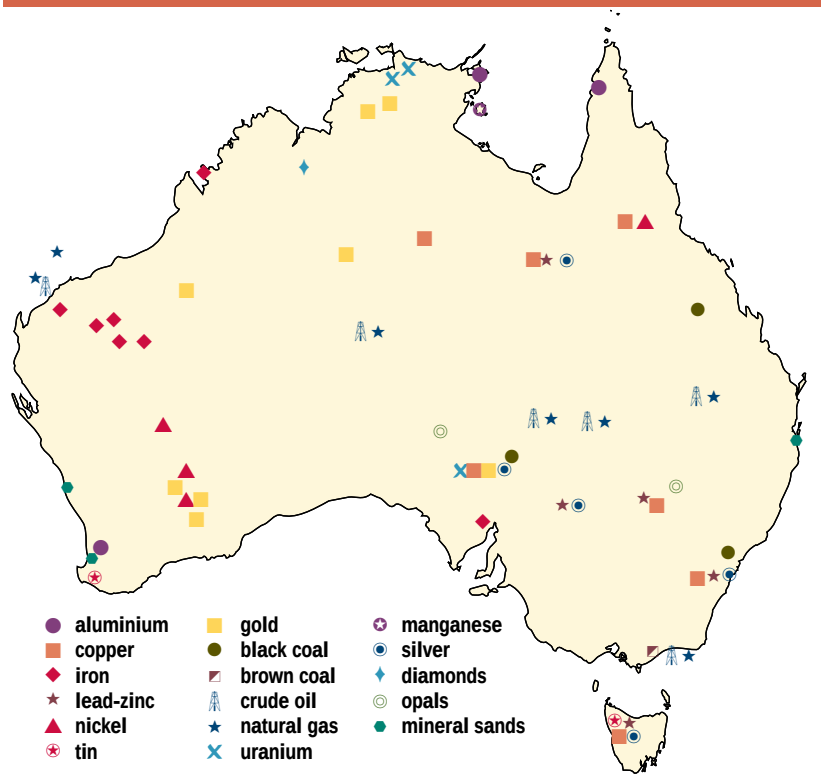
Urban areas greatly affect the pattern of run-off. Impermeable roads and buildings stop water from soaking into the ground, so it must be channelled into drains and then discharged — often in a polluted form.

Large, but diminishing, groundwater resources

The arid and semi-arid zones are well provided with water that has accumulated beneath the ground and can be used to supply wells or bores. The Great Artesian Basin, our biggest single source of this groundwater, underlies about 22 per cent of the continent (see Fig. 2.8). More than 4000 flowing wells have been sunk into this basin, but by 1990, just over 1000 bores had stopped flowing.

About 60 per cent of the country by area is totally dependent on groundwater, and a further 20 per cent uses appreciable amounts of it. Its quality varies; in some places it contains many dissolved minerals and may not even be suitable for irrigation. In others, it is useable for agriculture and as drinking water for humans. This groundwater resource has underlain much of the development of inland towns like Alice Springs, and of the pastoral properties in the arid zone. However, the rate of extraction has been increasing. In some aquifers, it is now much greater than the rate of recharge and so, inevitably, the resource will run out. Groundwater can also be — and in some places already is — subject to pollution, which can remain unnoticed for a long time (see Chapter 7).

Figure 2.9 Australia's mineral deposits



Source: adapted from AUSMAP Atlas of Australia, 1992.

Rich in minerals

Minerals of economic significance occur throughout Australia (see Fig. 2.9). The abundance of mineral resources per head of population is much greater than in most other countries. We have more than 20 per cent of the world's stock of recoverable bauxite, iron ore, uranium, mineral sands and diamonds, as well as other important mineral deposits, including large quantities of coal (most of which is low in sulfur). Extractable oil exists on land in the Amadeus, Bowen/Surat, Cooper/Eromanga and Perth basins and also under Bass Strait and off the coast of north-western Australia. However, the country is not self-sufficient in oil, with about 25 per cent of requirements being imported.

Hazards — a natural part of life

Drought, fire, cyclones, floods, tornadoes, venomous creatures and even earthquakes are all part of Australia's natural environment. Any picture of our environment must include these phenomena, and so too must our planning. Risk and uncertainty pervade every aspect of life here.

The sea

Our marine environment provides us with resources in the form of minerals, finned fish and shellfish, and important assets for recreation and tourism. Much of our trade is carried by sea, which provides a natural barrier to invasions of exotic species.

Australia's coastline (including that of its 12 000 or so islands) extends for about 70 000 km and comprises a range of conditions. In international law, Australia has primary management responsibility for waters extending for 200 nautical miles (about 300 km) from the coast of the continent and islands that are part of its territory — unless another country's zone intervenes (see Fig. 2.1). These waters, known as the exclusive economic zone (EEZ), cover a greater area than the country's land. In some cases, Australia has internationally recognised rights and obligations concerning the seabed of the continental shelf beyond the 200 nautical mile EEZ.

Hazards such as flood (above), fire and drought are a natural part of Australia's environment. Cyclone Tracy (left) devastated the city of Darwin on Christmas Day, 1974.

The continent lies between three ocean basins: the Pacific, the Indian and the Southern. The sea around the country spans four world ocean temperature zones, from tropical (sea-surface temperature of 25–31°C) to subpolar (5–10°C). Polar waters (-2–5°C) surround Macquarie Island and the Australian Antarctic Territory.

Because the sea moderates the climate, coastal areas generally experience much lower temperature extremes than the inland. The ocean takes much longer to warm up and cool down than the air. The sea also influences rainfall and patterns of air movement in coastal areas. Cyclones are generated over tropical seas.

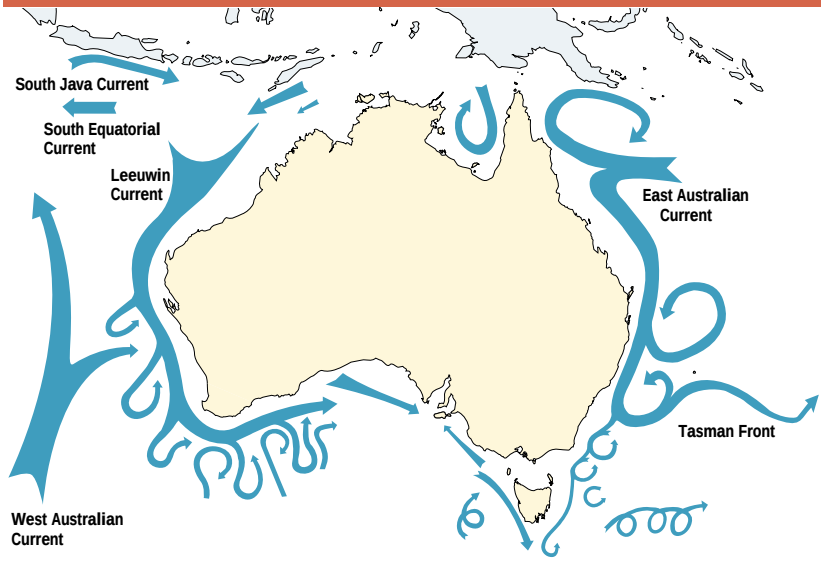
Australia has a major ocean current flowing southwards on each side of the continent (see Fig. 2.10). Coming as they do from the tropics, these currents bring warm water to both western and eastern coasts. This feature of two warm currents is unusual, as most other continents have one 'cold' current (coming from polar regions) down one side, and a warm one, from the tropics, moving along the other side.

The lack of upwelling of nutrient rich cold water is one reason why Australia's marine areas are not as highly productive as marine zones in many other countries. Another reason is that run-off into the sea on the shelf is low in nutrients. The total fish catch in our waters comes to only a small proportion of the world harvest, despite the large fishing zone.

Australia's most famous marine feature is the Great Barrier Reef, the world's largest continuous coral reef complex, which is about 2500 km long and contains thousands of separate reefs. We have many other reef systems, including coral growing in areas far from the tropics, such as Lord Howe Island. In fact, we have the largest area of coral reefs of any nation (see Fig. 8.10).

Our reefs face many pressures, including: sediments and nutrients from land disturbance, run-off of applied fertiliser and discharges of sewage; tourism and fishing in certain areas; and oil spills. Other potential threats are outbreaks of coral predators, such as the crown-of-thorns starfish in the outer central and northern Great Barrier Reef and snails (*Drupella* species) in Ningaloo Reef, Western Australia. The conservation and tourism values of Australia's reefs are becoming more important as the condition of other coral reefs in the world deteriorates. Coral reefs are now relatively well represented in marine protected areas, by far the largest of which is the Great Barrier Reef Marine Park, with an area of about 344 000 sq km. The management of the Great Barrier Reef, in particular, is a major environmental undertaking for the country because of the competing needs for: preservation of the natural area; increasing recreational tourism and coastal and island development; fishing (traditional, recreational and industrial); and the passage through the reef waters of large transport vessels.

Figure 2.10 Ocean currents surrounding Australia



Source: CSIRO Division of Oceanography.

Fraser Island; part of the World Heritage Great Sandy Region contains many unique features such as perched lakes.

Off the southern end of the Great Barrier Reef lies the world's largest sand island —Fraser Island, near Maryborough in Queensland. It is part of a 'sandy region', and contains many unique features, such as perched lakes. Both the Barrier Reef and Fraser Island are World Heritage Areas.

Australia's biological characteristics

Biodiversity

Australia is one of the twelve most biologically diverse countries in the world. Unlike the other 11, it has the development and wealth to research and protect its diversity. However, it has a small population and a large land area, and the number of ecosystems and species to research is also large. Consequently, the continent's biodiversity is still far from fully known. Many aspects of this diversity, such as our richness in lichens, ants and fungi, are not apparent to the casual eye.

Endemism

Australia and New Guinea share a common biological inheritance, now greatly modified by environmental differences. Australia has considerable variety in its living organisms and accommodates many groups of endemic organisms (those that exist nowhere else – see Tables 2.2 and 2.3). Its biological uniqueness has come about partly because it has been so isolated from the world's other landmasses for so long.

Two genera dominate the continent's trees

Like other continents in the southern hemisphere, Australia has mostly evergreen trees, but the

Table 2.2 Endemism in Australian mammals

	Total no. of species[1]	Endemic species	% endemism
Monotremes[2]	2	1	50
Marsupials[3]	141	131	93
Bats[4]	69	40	58
Rodents[5]	65	57	88
Seals etc[6]	4	1	25
Dugong[3]	1	0	0
TOTAL	282	231	82

Notes:
1. Excludes oceanic islands and Antarctica.
2. Strahan, 1988.
3. R Strahan 1993, pers comm.
4. G Richards 1993, 1994, pers comm. This figure includes only described species; a further 18 nominal species await description, and 16 of these are thought to be endemic.
5. R Strahan 1994, pers comm.
6. Strahan 1988. This figures includes only those species which breed or used to breed on the Australian mainland or Tasmania (including King Island). A further four species are casual or accidental visitors.

Source: adapted from DEST, 1994.

Table 2.3 Numbers of primitive angiosperms

Plant family	World species	Australian species
Order magnoliales		
Annonaceae	574	29
Austrobaileyaceae*	2	2
Eupomatiaceae	2	2
Himantandraceae	2	1
Winteraceae	60	10
Myristicaceae	120	1
Order Laurales		
Atherospermataceae	8	8
Gyrocarpaceae	7	1
Hernandiaceae	21	3
Idiospermaceae*	1	1
Lauraceae	1260	62
Monimiaceae	95	19
Trimeniaceae	7	1

*endemic families

Source: adapted from DEST, 1994.

majority are not conifers. Instead, eucalypts and acacias define much of the landscape. Few other land areas in the world are so completely dominated by just two genera of trees. Acacias as a group are not only found here. Their distribution reflects the existence of the super-continent Gondwana to which Australia once belonged. But, apart from a few species in New Guinea and other nearby islands, more than 500 species of eucalypt are uniquely Australian.

Sclerophylly

One particular quality of much of our flora is the presence of hard, dryish, leathery, spiny or small leaves. Plants with these features are called sclerophylls. Such leaves lose less moisture and are also tougher, so they last longer and need replacement less often. The leaves are also less attractive to grazing animals and may be harder to digest. As a result, sclerophyllous vegetation is well adapted to dry conditions and low-nutrient soils — a great advantage across much of present-day Australia. This may explain why sclerophylls are so prevalent among our native plants. The low soil nutrient level in many areas is not the problem for them that it is for many of the introduced species used in modern agriculture.

Marsupials and monotremes

Australia holds the undisputed title as the world's centre for marsupial mammals. These animals, born in a tiny, immature state, complete much of their development in a pouch. Although several marsupial groups thrive in South America, which was once connected to this continent through Antarctica, and one species of opossum is found in North America, Australia harbours the widest range of marsupial families. We have 144 marsupial species, including koalas, wombats, kangaroos and wallabies. They have been extremely successful.

Monotremes are even more special to Australia. These break some of the familiar 'rules of mammals' by laying eggs, like reptiles and birds, but producing milk to nurture their young, and by having less effective body temperature regulation. There are only three species of monotreme in the world: the platypus and two species of echidna. One echidna species occurs in New Guinea, but the platypus is uniquely Australian.

Other fauna

Despite our legacy of unique marsupials, most native mammals are not marsupials. Most of them are placentals (the young remain in the womb for much longer than marsupials and there is no pouch). These include: bats, such as flying foxes; rodents, such as the water rat; and marine mammals like seals, dugongs and dolphins. Dingoes are not native but came here with people at least 3000 years ago.

Much of Australia's faunal richness lies in its birds, reptiles, amphibians and invertebrates. About 93 per cent of the frogs and 89 per cent of the reptiles are found nowhere else. Our arid zones are particularly rich in lizards compared with similar areas on other continents (see Table 2.4). We also have a great variety of ants. The arid zone supports a rich and diverse array of termites that do the work of decomposing plant matter, a job carried out by other soil fauna and fungi in wetter areas. Termites and their distinctive mounds are extremely numerous — it has been calculated that the biomass (total weight) of termites per hectare in many parts of the semi-arid zone is greater than that of the cattle that graze these regions. Indeed, despite the prevalence of kangaroos, there is no doubt that the continent's major herbivores are ants and termites.

Two genera, the eucalypts (left) and the acacias (below), dominate the woodlands and drier forests of Australia.

Table 2.4 Number of species of lizards in 10 hectare desert study sites on three continents

Lizard family	North America	Africa (Kalahari)	Australia
Agamidae		1	2–8
Chameleontidae		1	
Gekkonidae	1	4–7	5–9
Helodermatidae	1		
Iguanidae	3–8		
Lacertidae		3–5	
Pygopodidae			1–2
Scincidae		3–5	6–18
Teiidae	1		
Varanidae			1–5
Xantusidae	1		
Total	**4–11**	**12–18**	**18–42**

Source: adapted from Pianka, 1986 as cited by DEST, 1994.

People brought the dingo to Australia at least 3000 years ago (top).

The koala, one of Australia's 144 marsupial species (centre).

Introduced species, such as the rabbit, have been responsible for many of the extinctions of native animals (above).

Introduced species that 'all ran wild'

Australia's flora and fauna have changed dramatically, and irreversibly, over the last 200 years. Species ranging in size from the Asian water buffalo to the AIDS virus have been introduced. The result has been a complete and rapid change to much of the country's natural ecology. Introduced species, including domesticated stock, have been responsible in part, for many of the extinctions of native mammals in the central zone of the continent — the region with the least human habitation!

Australia's new human arrivals didn't just bring in their northern hemisphere species, they also modified the environment in ways that helped many of the introduced species to spread. Roads, railways and other corridors in the bush often fragmented native populations and gave access to many introduced species — especially plants. The new weeds colonised roadside verges. Four-wheel drive vehicles and even bushwalkers can still, unwittingly, spread plants and soil fungi into new areas.

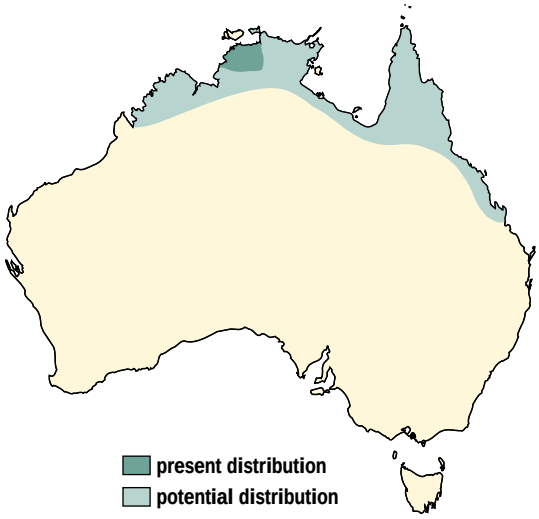
Introduced species — whether rabbits, cane toads, bitou bush or *Mimosa pigra* (see Fig. 2.11) — occasionally enter our awareness, but the effects of the many introductions go much further. Australians today depend totally on introduced species. Our agriculture relies on introductions that have changed the fabric of the land — its vegetation cover, sand dunes, water holes and creeks. New ecological associations are forming between native and introduced species. For example, new soil fungi interact with the roots of native trees. Introduced bees pollinate native plants and native birds eat seed from introduced grasses. Despite efforts at eradication, it seems that most introduced species are here to stay — even if we succeed, in some cases, in keeping their numbers in check. That they will continue to affect the natural environment is obvious, but exactly how remains to be seen.

Tropical rainforest — rare but rich

As might be expected, true tropical rainforest is rare in Australia. Patches exist in northern Queensland (see Fig. 2.12). In addition, small stands of monsoon rainforest occur in parts of the Northern Territory, Western Australia and elsewhere in Queensland. The real tropical rainforest receives about ten times the annual rainfall of the continent's arid zone and, most importantly, its rainfall is predictable.

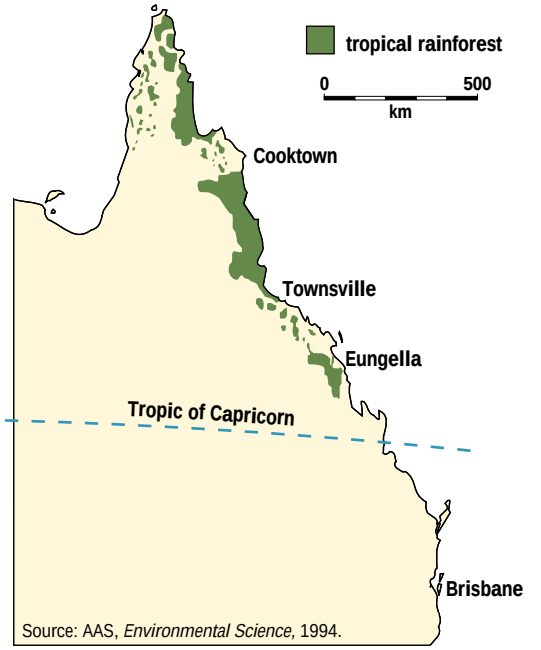
The tropical rainforests of northern Queensland occur from sea level to more than 1600 metres altitude, and include a number of different types of vine forests and communities, often in small pockets interspersed with open forests, woodlands, swamps and mangroves. They are of special value both nationally and globally, and provide some of the world's most important ancestral links in the history of plant evolution. They are, for example, the centre of diversity of the cycads, and contain the world's greatest concentration of primitive flowering plants: of the 19 known families of primitive flowering plants, 13 are found in north-east Australia and two of these are found nowhere else. Some 1161 species of plants have been recorded in the area. One-third of them belong to genera of which they are the sole representatives. An extraordinary number of flowering plants

Figure 2.11 Distribution of the pest weed *Mimosa pigra*



Source: compiled by ANCA.

Figure 2.12 Distribution of tropical rainforest



Source: AAS, *Environmental Science*, 1994.

belong to these monotypic genera: 43 have been recorded, of which 37 are endemic to Australia and 28 to the area. Many rainforest plants are known from only a few populations.

Faunal diversity in the wet tropics is similarly rich, with 47 species of frogs (23 per cent of the Australian total) found there — 19 of them endemic to it. Some 128 species of birds enrich the area, and 89 mammal species, including some 60 per cent of Australia's bat species. Twenty three per cent of our reptiles also occur there. The number of invertebrate species is likely to be enormous, but remains largely unknown. A survey at Bellenden Ker found more than 4385 species of invertebrates. Of the 1514 beetle species identified, 86.5 per cent were unnamed. The mountain tops within the tropical rainforests are like geological islands, and host many species that appear to be of great antiquity, with some perhaps unchanged from Gondwanan times.

Birth of a continent

The instantly recognisable outline of Australia today has not always existed — and the biological and physical features of our continent have not always been the way they are now. If we view things on long-enough time scales, Earth's surface is a constantly moving jigsaw of landmasses and oceans: nothing is static. What seems so permanent now is merely one frame in a long film full of movement and change. About 1000 million years ago (a time span less than one-quarter of Earth's age), the planet would have been unrecognisable. At that time, no life existed on land, and only the simplest forms in the sea. There would have been no soil; and the atmosphere was unbreathable, as living cells in the sea had not yet released enough oxygen. The land and its features would bear no relation to any of today's maps. Yet part of what was to become Australia was there. Much of the western two-thirds of today's continent (the most ancient part) existed within a larger landmass.

Starting about 450 million years ago life appeared on land. Much later (about 160 million years ago), through the slow movement of the vast geological plates riding on Earth's mantle, the super-continent Pangaea, containing the forerunners of all today's major landmasses, split into two. A northern super-continent, comprising most of North America, Greenland and Eurasia was completely separated from a southern super-continent called Gondwana. As well as much of present-day Australia and New Guinea, Gondwana included what is now Antarctica, India, South America, Africa, Madagascar and Arabia, and a mass that later became New Zealand. (At various times, different parts of the Gondwanan landmass were below the sea.)

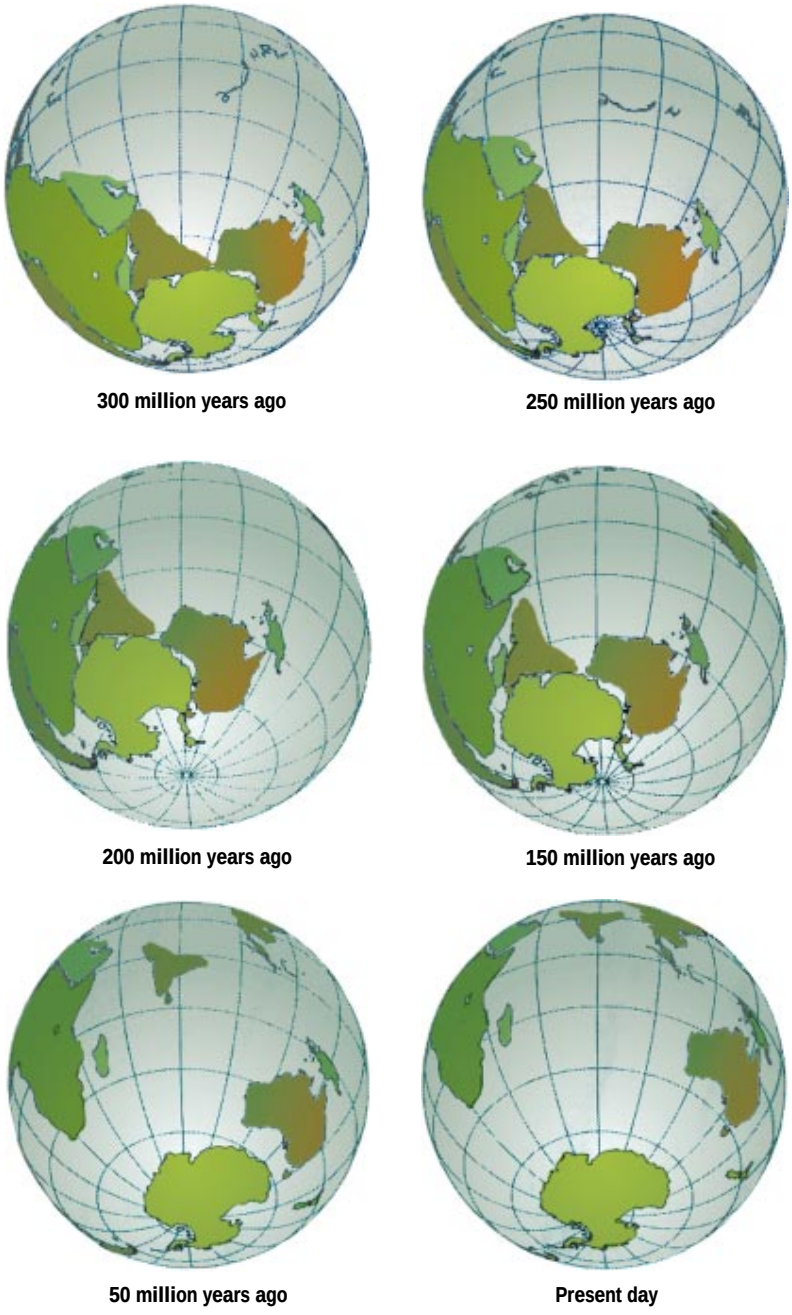
Eventually, Gondwana started to break up (see Fig. 2.13). Land destined to become India, Africa and Arabia separated off at different times and started to fan out northwards. New Zealand broke away about 80 million years ago. The area of land that is now Antarctica lay between Australia and South America, joining all three together. (Antarctica had no permanent icecap then, because of its different position, and it was forested.) As continents drifted, they moved into different climate zones.
The changed position of the continents could affect the climate of a region, because ocean and atmospheric currents are all influenced by the presence of landmasses. On the slowly moving continents, geographical features — such as the sizes and directions of river systems, and rates of erosion — also changed. So too, of course, did the types of living organisms.

Australia's tropical rainforests are rich in endemic species of plants. Many of them provide important ancestral links in the history of plant evolution.

The development and spread of Australia's main groups of higher plants occurred while Gondwana was still intact, but undoubtedly flora and fauna varied across the massive super-continent. Those parts more distant from what is now Australia probably had less-closely related organisms before the break-up. That is why we share many biological groups with South America and some with New Zealand, and have fewer in common with Africa and India.

Very little mountain-building has occurred in the land that is now Australia — for about 100 million years or more — in marked contrast to the creation of the Himalayas, the European Alps and the American Rockies. These are all quite recent in geological terms. New Guinea has been, and continues to be, the site of mountain-building and volcanic activity as the Australian landmass pushes into Asia. The absence of new mountains here (apart for some uplift in eastern Australia that continued through the Tertiary period) has affected the present-day nature of our soils and water flows. Many of our rivers have occupied their present positions for far longer than those in most other countries.

Figure 2.13 The break up of Gondwana



Source: Bureau of Mineral Resources, Geology and Geophysics, as cited in ABS *Yearbook Australia*, 1988.

About 65 million years ago, a mass extinction occurred across the world. Many groups of organisms quickly disappeared from the fossil record, including the great variety of dinosaurs. As a result, many new organisms evolved over the succeeding millions of years, and the previously inconspicuous mammals diversified into a range of different forms. Fifty million years ago, Gondwana (comprising the land for only the three future continents) was probably a place of damp forests where tree ferns, conifers and some flowering plants thrived in a fairly constant cool to warm and wet climate. Mammals — both placental and marsupial — did well after the removal of the dinosaurs and related reptiles, and both types probably existed in Gondwana. Later, marsupials declined in South America and placentals gained the ascendancy there. Marsupials became extinct in the cold of Antarctica, but they thrived in Australia, where new forms continued to evolve. Recent evidence suggests that early types of placental mammals, which died out, may have existed here. Mammals of the third type — the monotremes — are now only found in Australia, although they once occurred in South America.

Australia started to separate from Antarctica about 53 million years ago. At that time its southern boundary was near the Antarctic Circle, and daylight would have been almost non-existent during the winter. Despite this, plants seem to have thrived, probably because the whole world was warmer and wetter then.

The last point of connection to the Antarctic landmass was through land that is now Tasmania, but this broke about 38 million years ago, and a channel of deep water formed between the two continents. Australia became a separate continent — and started to develop the unique characteristics found today. Eucalypt pollen first appeared in the fossil record at about that time. Since then — and until very recently in geological time — Australia and Antarctica have been quite isolated from all other landmasses (unlike South America, India and Africa, which all eventually came into contact with northern landmasses). The separation caused circular currents in the ocean and the atmosphere — the so-called circumpolar currents — to develop around Antarctica. These restricted the transport of heat from tropical latitudes. Antarctica became colder and, although marine life and birds survived, eventually all higher terrestrial life across the continent disappeared, so removing many of the living organisms most closely related to those in Australia. The isolation of Australia allowed its flora and fauna to develop for about 30 million years

without any significant input from elsewhere. Many Gondwanan species survived relatively unchanged.

Australia drifted further northwards. By about 20 million years ago it started to become drier, especially in the southern inland. Sclerophyllous plants were at an advantage in these less stable conditions and so they spread. Eucalypts, banksias and hakeas developed into many forms. Grasslands replaced areas of lush forest. New marsupial species evolved. Acacia pollen first appeared in abundance about 25 million years ago, probably as a result of the increased aridity. (It is likely that acacias had been present from long before, as their distribution today — in Australia, Africa, India and South America — suggests that they were Gondwanan plants.)

In general, Australia's flora and fauna are a mixture of the original Gondwanan stock, modified over the millions of years of separation, and the more recent arrivals from Asia.

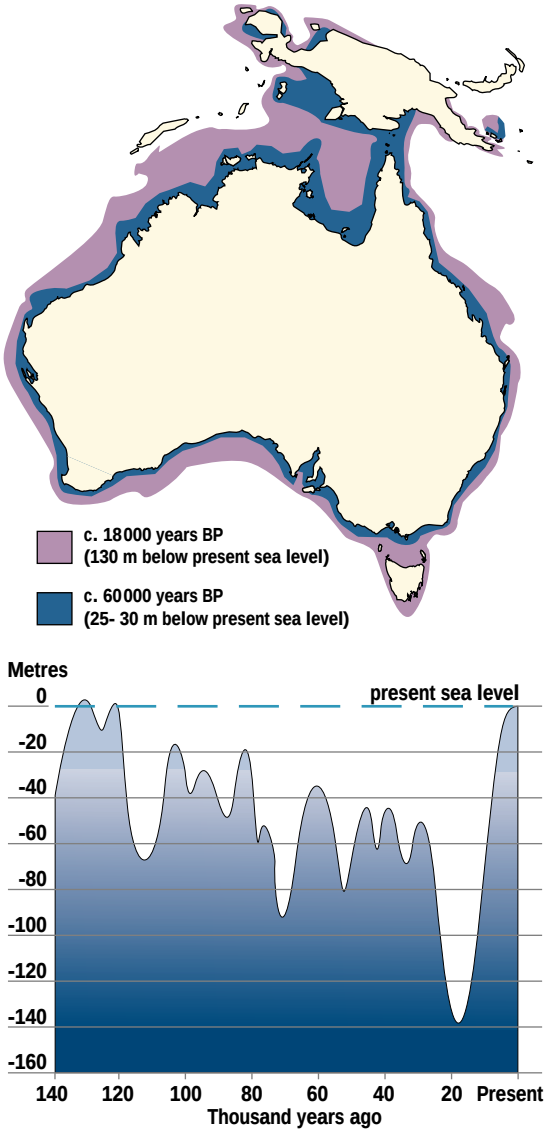
During the last few million years, the main influences on our climate have been alternating glacial and interglacial phases. For most of this time Earth has been in the grip of so-called Ice Ages, or glacial periods, when the planet-wide average temperature is lower and the atmosphere is drier. During peak glacials of a few thousand years, water becomes frozen at the poles and in glaciers, so sea levels are lower. The briefer peak interglacials are characterised by warmer, moister conditions when sea levels rise and glaciers retreat. Phases of cooler, wetter weather and warm, dry phases intersperse the tens of thousands of years between these extremes. During the peak of the last glacial period, about 18 000 years ago, the sea level was some 120 metres lower than it is today. Several parts of the world, now separated by sea of that depth, were therefore joined. As Fig. 2.14 shows, the islands of New Guinea and Tasmania were joined to mainland Australia and the Gulf of Carpentaria was land, although a large lake existed in the middle of it. For much of the past 1.8 million years, Australia and New Guinea formed one land mass. Unlike much of the northern hemisphere, mainland Australia was too warm to suffer from widespread glaciation, but the climate became cool, dry and windy during the glacial periods. At these times dunes covered more of the country, and rivers and wind carried away a lot of dust from the soil. Elsewhere, an icecap covered the central highlands of Tasmania. Large glaciers originating from it carved deep features in the landscape.

Earth is now in an interglacial period, which has lasted for about 10 000 years. It was during an earlier glacial period that the first humans would have reached a much larger Australia across smaller stretches of water from Asia, so starting a series of new changes to the continent.

Australia's slow northwards drift, at a rate of about 100 km every million years (or 10 cm a year) continues today. Now we are closer to Asia, but our geological past explains why our flora and fauna resemble those found in far-away South America and are, in general, so different from those of most of our near neighbours.

The Nullarbor Plain is a distinctive feature of the Australian landscape. It was once the bottom of a shallow sea.

Figure 2.14 Sea level changes over the last 140 000 years



Source: AAS, *Environmental Science*, 1994.

Humans in the environment

It may never be known when the first humans arrived in Australia. Many Aboriginal people hold the traditional belief that their ancestors have always dwelt here. Archaeological evidence shows that human settlement goes back at least 50 000 years, and some archaeologists believe it goes back even further.

The consensus of opinion among prehistorians is that the first people came from the north, through south-east Asia. They came at a time when sea levels were lower than today's. Their journeys across water would have been shorter but still perilous. Different groups could have come at different times over thousands of years. By at least 20 000 years ago people had spread to all parts of the greater land mass of Australia, including Tasmania and New Guinea. Rising sea levels later cut off the land bridge to Tasmania about 10 000 years ago, effectively isolating the people there.

Despite the use of agriculture by the inhabitants of New Guinea and the Torres Strait Islands, and the likelihood that people in northern Cape York knew of it, it seems that the Aboriginal peoples did not develop formal agriculture on the Australian mainland. The persistence of hunting and gathering might well have resulted from the low productive potential of most of the country compared with the lush fertility of most of New Guinea. However, it is clear that Australian Aboriginal peoples knew a great deal about the resources of the land, and how to care for certain plants. Like all humans, they modified the environment to improve their own well-being — mainly through the use of fire. It is also possible that continuous hunting brought many larger animal species to extinction, although extinctions could have resulted from climate change, or use of fire, or a combination of all three. This area is still subject to scientific debate.

Philip Langley, from the Aboriginal and Islander Dance Theatre breathes life into an Aboriginal tradition going back many thousands of years.

Lalai (Dreamtime)

Dreamtime,
The first ones lived, those of long ago.
They were the Wandjinas—
Like this one here, Namaaraalee.
The first ones, those days,
shifted from place to place,
In dreamtime before the floods came.
Bird Wandjinas, crab Wandjinas
Carried the big rocks.
They threw them into the deep water
They piled them on the land.
Other Wandjinas—
all kinds—
She the rock python,
He the kangaroo,
They changed it.
They struggled with the rocks,
They dug the rivers.
These were the Wandjinas. They talk with us at some places they have marked.
Where the sun climbs, over the hill and the river they came
And they are with us in the land.
We remember how they fought each other at those places they marked—
It is dreamtime there.

Some Wandjinas went under the land,
They came to stay in the caves
And there we can see them.
Grown men listen to their Wandjinas.
Long ago, at another time,
these Wandjinas changed the bad ones into the rocks
And the springs we always drink from.
These places hold our spirits,
These Wunger places of the Wandjinas.

Recounted by Sam Woolagoodjah, elder of the Worora people, north-west Australia.
Extract from translation by Andrew Huntley from the prose version by Michael Silverstein. In *The New Oxford Book of Australian Verse*. (Chosen by Les A Murray. Oxford University Press, Melbourne 1987.)

Coupled with the vegetation changes following regular burning, the variety of animal species changed.

People spread across the whole of the continent and adapted to the various climates and resources available. Their relative isolation from the rest of humanity, particularly in southern Australia, lasted for tens of thousands of years, but some interchange with the peoples of the island of New Guinea and nearby Indonesian islands continued.

Various European and Asian navigators were aware of part of the coastline of the continent by the 1600s. The Englishman Captain Cook mapped much of the east coast in 1770. More than a decade later, the British Government decided to start colonising the country. In particular, the Government wanted to use the opportunity to deal with overcrowded jails — and a large population of what it deemed criminals — by sending the

convicts away, although strategic and trade considerations also played an important part in the decision to start colonisation. Amid optimistic ideas of boundless plenty in the new land, England dispatched a collection of ships (the First Fleet), which landed in Botany Bay (now part of the greater Sydney metropolis) in 1788 to start a penal settlement.

The settlers had no understanding of their new environment. They could not know of the great variability in climate, the low nutrient status of the land and the importance of fire as a land management tool. Their main imperative was survival and the prevention of famine. The environment turned out to be more difficult than expected and both it and its original human inhabitants soon came to be viewed as generally alien and hostile.

In 1789 Arthur Phillip, the Lieutenant Governor of the new colony, wrote:

> '... in the whole world there is not a worse country. All that is contiguous to us is so very barren and forbidding.... here nature is reversed [and] nearly worn out.'

Of course, not all the early settlers felt the country was hostile. Gradually, attitudes to the environment swung to a different extreme, and an over-optimism about its potential came to prevail.

Conflict between the settlers and the original inhabitants soon began and, despite the efforts of various peaceful individuals on both sides, tragically continued in violent form into this century. As was the case wherever Europeans colonised, diseases, especially smallpox, preceded the advance of settlement and made colonisation easier by devastating the Aboriginal peoples. Despite resistance in some parts of the country, colonists killed Aboriginal peoples outright (by gunshot or poison) or indirectly (by taking their lands). In Tasmania the tribes were almost wiped out. But the north of the country was much more difficult for the European settlers because they were not used to the harsh conditions. Many early settlements there failed.

The Aborigines, having lived on this continent for so long, were much better adapted to its ways than the newcomers. They had a detailed knowledge of their land and a deep emotional and spiritual attachment to it. However, their land was wrested from them and the way the natural environment was treated changed greatly as a result.

The newcomers tried to impose their agriculture, using species adapted to humid, temperate and predictable climates, onto a country that did not have the soil, the water or the climatic stability for it. They did not understand the use of fire as a land management tool, or the possibility of using the well-adapted native plants and animals for food. But, above all, they failed to appreciate the constant inevitability of both flood and drought.

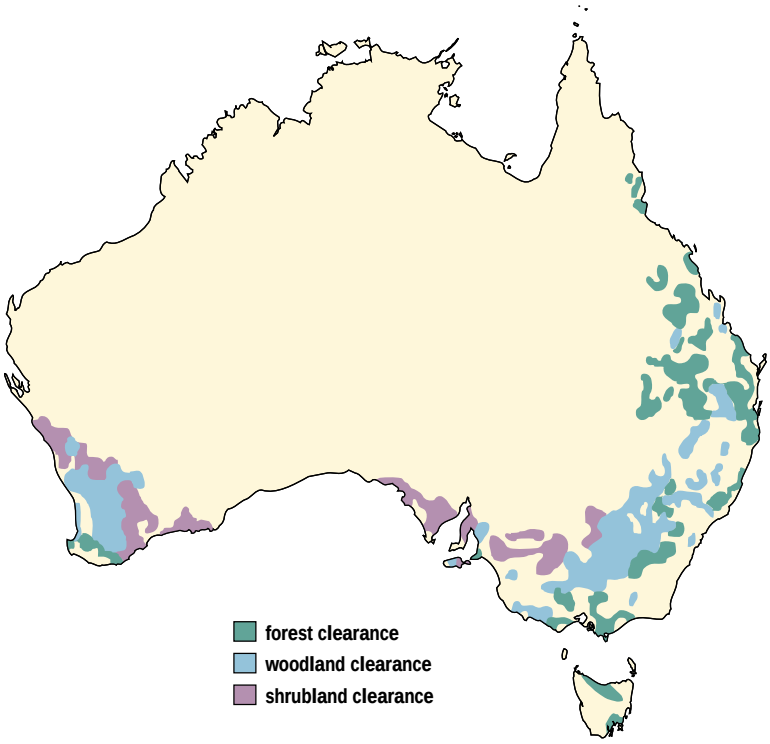
As the decades passed and the new settlements became self-sufficient, European settlers spread further into the continent, with great difficulty, always trying to introduce agriculture and make money from the land. Every so often they came across areas of good plant growth, and were deluded by the apparent lush aftermath of good rains. This, of course, was not the norm; but the settlers felt that the dry spells were just a run of bad luck and that 'normal' conditions of good rain would quickly be reinstated. Even today, many people consider droughts freak 'acts of God' for which compensation must be paid, rather than as naturally recurring events that are a normal part of the Australian environment.

'The prince at the Rabbit Warren, Barwon Park' from the *Illustrated Australian News*, 20 December, 1867. European settlers brought with them an alien culture to their new land.

European settlement of Australia started at the margins — the coastline — which was all that was accessible to the colonists. Today's pattern of urbanisation reflects this — all the major cities are coastal and are sited on fresh-water supplies and near harbours. Each major settlement became a separate colony in its own right; each colony later became a State. Agricultural areas surrounded the early cities, and eventually they prospered because they were located on trade routes and in well-watered areas. After making some adaptations to Australian conditions, agriculture succeeded, but continued to rely, as it still does, on introduced species. Throughout, the new arrivals had to learn to come to terms with the land they had acquired — especially those parts of it that they could not change.

The new settlers colonised more and more land, and opinions changed from the early dismay into unrealistic expectation. In some respects the environment was still hostile but, the pioneers felt, it could be 'tamed' and transformed into a land of great wealth. Societies were set up to bring in many species from Europe to increase the feeling of being 'at home' in the new land. Other alien species established themselves when they escaped from farms, were let loose or came in by accident. As a result, thousands of plant and animal species never before known here now exist in the wild in Australia. These have changed the natural environment utterly and irrevocably.

Figure 2.15 Changes in vegetation since 1788



Source: AUSMAP Atlas of Australia, 1992.

As the colony started to export its agricultural and, later, mined produce, it prospered. Visions grew of a wealthy and powerful nation, rivalling the United States of America. Politicians and journalists in the late nineteenth and early twentieth centuries spoke of Australia as a land of boundless plenty with a potential population of 80–100 million of British stock in the new millennium. The sense of future glory spurred people on and, coupled with developing national pride, started the movement to join up, or federate, all the separate colonies into one nation. In 1901 the nation we know today — the Commonwealth of Australia — came into being with the act of federation and the creation of a federal government. Dealing with conflicts between the States over resources, trade and defence provided some of the early imperatives for the new national government.

The rapid build-up of people with new cultures and ways of treating the environment imposed many pressures on the country. The introduced species — especially the rabbit — became a curse. They disturbed the agriculture that was so important to the nation, as well as devastating native ecosystems. Feral cats and foxes preyed on native animals, and Australia now has the world's worst known rate of mammalian extinction. High populations of grazing animals during good times became a liability during droughts, and then overgrazed the remaining vegetation, leading to soil erosion. The clearance of deep-rooted native trees for agriculture in many areas caused the water table to rise, bringing salts close to the surface and killing crops.

Only this century did people begin to appreciate the many limitations of Australia's environment. The idea of a huge, hostile land that would slowly be tamed and brought under control, then to offer limitless opportunity, died hard. For example, in 1847 it was claimed that the Big Scrub of northern New South Wales would need five or six centuries of toil before it could be cleared and the land used by the settlers. It must have seemed almost limitless. But by 1900 it was mostly gone. Technology had greatly speeded up the rate of change. In another case, the thylacine, a marsupial predator in Tasmania, was seen as a threat by farmers who thought it would kill their sheep. The government paid bounties for its destruction. Three decades of hunting and trapping reduced the thylacine to the verge of extinction. Bounty payments ceased, but too late to save the thylacine.

Population

We now realise that Australia has a small area of arable land compared with other continents, and that its relative lack of water puts restrictions on dense settlement in many areas. The question of how many people the place can support — at a reasonable lifestyle and in a sustainable fashion — is now the subject of national debate.

Table 2.5 Population growth rates

	Average annual rate of growth (%) 1986–91
Australia	1.6
Canada	1.3
China	1.5
Indonesia	2.3
Japan	0.4
Korea	1.0
New Zealand	0.8
Papua New Guinea	2.1
United Kingdom	0.2
United States of America	1.0

Source: Australian Demographic Statistics, 1995 and United Nations Demographic Yearbooks.

Table 2.6 Australia's capital cities

City	Population 1993 ('000)
Sydney	3 719.0
Melbourne	3 187.5
Brisbane	1 421.7
Adelaide	1 070.2
Perth	1 221.3
Hobart	193.3
Darwin	77.4
Canberra	298.6

Source: Australian Demographic Statistics, 1995 and unpublished ABS data.

Estimates of the Aboriginal and Torres Strait Islander population of Australia when Europeans arrived in 1788 range between 300 000 and 1 500 000. Whatever the figure, it is clear that following European settlement the population of Aboriginal people declined rapidly. After 70 years, the European population had reached one million, but the Aboriginal population was not recorded. In March 1995, the Australian population stood at 18 million. The latest one million Australians were added in just five years. With a birth rate of about 15 per 1000 people and a death rate of about seven per 1000, the country's population, in theory, should be growing by natural increase at the rate of about eight per 1000 per year, or 0.8 per cent. This is fairly low by global standards, but one of the highest rates of any developed country.

Added to this is the growth due to immigration. During the 1980s the total population growth rate was about 1.6% annually. This had declined to 1.1% in 1993/94. (The precise figure fluctuates with changing annual immigration quotas.) This decline in the rate of population growth is due to a reduction in the level of migration to Australia; net inward migration declined from around 0.8% during the 1980s to 0.2% per annum in 1993/94 (see Table 2.5 and Fig. 2.16).

Even if net migration were reduced to zero, Australia's population growth would continue by natural increase until about 2026, when it would peak at about 20 million. This is despite the fact that the fertility of the population is below replacement level (defined as each woman of reproductive age having one surviving daughter). It is often not appreciated that a population can continue to grow for a time even when fertility is below the replacement value. Without migration or a change in the fertility rate, the Australian population would be expected to start slowly declining after 2026. Figure 2.17 shows projections of population to 2086 with different annual net migration figures.

Sydney Harbour; most Australians live in the eight capital cities, with Sydney and Melbourne accounting for 39 per cent of the country's population.

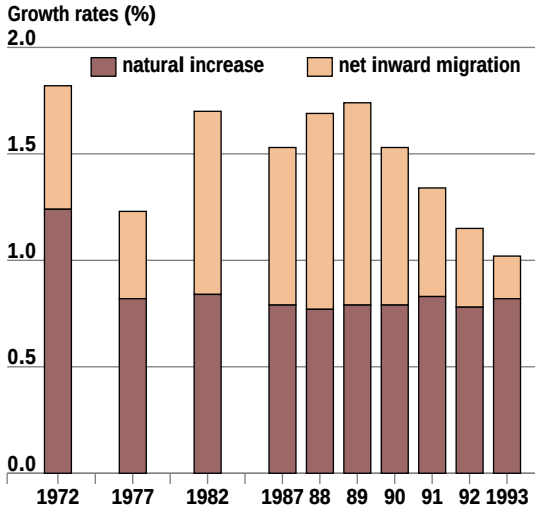
Where we live

The aspirations of many Australians are for a detached (preferably single-storey) house on a block of shaded land, near the beach, but well-provided with amenities. Although not all live this way, it has been called the 'Australian dream'.

While Australia has a very low population density by world standards, the average figure for the whole country is entirely misleading, as the distribution of population is very uneven, with most of the people concentrated in a small area. More than 80 per cent of the entire population live on just one per cent of Australia's land surface, most of them in the eight capital cities. Of these, the largest two — Sydney and Melbourne — together account for 39 per cent of the country's population. Each is more than double the size of the next largest city, Brisbane (see Table 2.6).

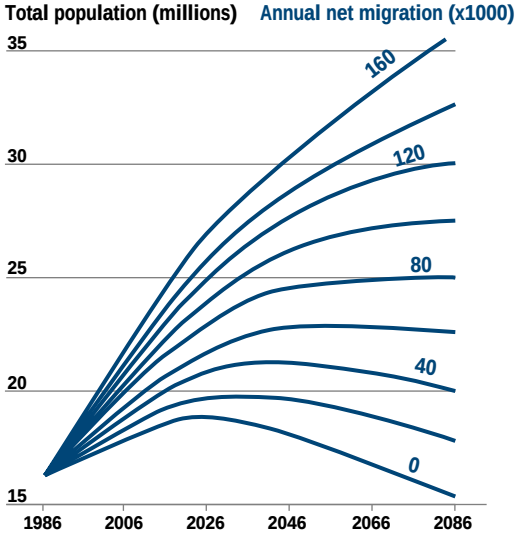
In terms of numbers of people, the capital cities tend to dominate their respective States or Territories. Only Tasmania, Queensland and the Northern Territory have capitals containing fewer than half their populations.

Figure 2.16 Population growth



Source: ABS, *Yearbook Australia*, 1994.

Figure 2.17 Projections of population growth



Source: AAS, *Environmental Science*, 1994.

Outer suburb, Canberra; urban sprawl has resulted in the creation of new suburbs away from the city centre.

Patterns of settlement

Most settlement lies in two widely separated coastal regions — the south-east crescent (which stretches along the coast from Bundaberg to Ceduna) and the south-west, stretching southwards from Perth. The former is by far the larger region. With the exception of a few small towns, the interior of the continent is not densely settled. However, it is far from being the 'dead heart' that has sometimes been portrayed.

The high level of urbanisation has major implications for the environment, because it means that many pressures are concentrated in a small area. Even though most people live in a very small part of the country, other human impacts have extended to every part of the continent, including the largely uninhabited arid areas. Indeed, the arid zone has suffered more from extinctions than the zones of denser human habitation.

Cities

All the major Australian cities are coastal, and occupy areas with reasonable and reliable rainfall.

Unlike the older ones of Europe, for example, Australian cities have experienced most of their development since the advent of the railway and motor vehicle, and this has determined their sprawling character. They are not compact, as were cities when people moved on foot or by horse. This early pattern has been exaggerated by rapid population growth, and particularly the desire of migrants to settle in the existing metropolises. As a result, cities have expanded outwards, encroaching on well-watered, often fertile land, as well as stretching along the coastlines and transport links.

The population densities of our cities remains low by world standards (see Table 3.5) and many urban Australians enjoy living in one- or two-storey homes with a garden. But countering this is the phenomenon of urban sprawl, where cities encroach on natural areas that serve as their water catchment and for recreational opportunities in natural settings. As well, extended cities mean longer journeys to and from work, which has generally meant an increase in private car ownership and use, and hence in air pollution. In addition, a population spread out over a greater area can consume more materials per capita in building, transport and infrastructure than a more compact one.

Urban sprawl has also resulted in the rapid creation of new suburbs, far from the city centre, often with few amenities in their early stages. This can cause either social isolation or car-dependency and congested roads. However there are some positive aspects of the new suburbs. Land use conflicts can be avoided and there is more open space. The suburban backyard is the location of many recreational activities (usually undervalued or un-valued in economic terms). These new suburbs have allowed many Australians to realise their goal of owning their own home which they could not otherwise afford.

How we live

Most Australians live in suburbs, own a private vehicle and own, or are buying, one of the 5.8 million occupied dwellings in the country.
Of the labour force of about 8.6 million, most are employed in the service, finance and retail trades, while about 16 per cent work in manufacturing and industry, and a mere six per cent farm vast expanses of land. About eight per cent of the workforce was unemployed in 1995 (as the nation recovered from the economic downturn of the early 1990s).
For those adults in full-time work the average wage was $692 a week for males and $550 a week for females.

In comparison with most of the world, the health of the population as a whole is good, and the death rates are low. Most babies born survive to adulthood: Australians can expect to live to be 74 years old, if male, and to 80 if female. The major killers could be described as 'diseases of affluence' (cardiovascular conditions and late-onset cancer, which is not apparent in societies where adults die young).

About three million young Australians attend school, nearly three-quarters of them going to government schools. Older students can attend one of the country's 36 universities, or receive technical and vocational training at colleges of Technical and Further Education.

Most Australians speak English, the national language; about 2.4 million speak another language at home, the main ones being Italian, Chinese and Greek. Nearly all Australians are literate. A great variety of languages are represented here; however, before the arrival of Europeans, there were even more, because of the large number of quite distinct Aboriginal languages — many of which have now been lost.

In their spare moments (when not working, travelling or shopping), Australians spend most time watching television. The next most popular activities (by time spent) are reading and organised sport. Fishing is a particularly popular outdoor pastime. It is estimated that about 4.5 million Australians go fishing at least once a year.

The average figures for Australian wealth, health and life expectancy — comparable with the best in the world — hide the fact that a proportion of the population show the characteristics of a much poorer and less developed country. The Aboriginal and Torres Strait Islander people — the original inhabitants — have lower earnings, higher infant mortality rates, a greater incidence of preventable disease, lower life expectancies, a greater rate of population increase and lower literacy.

What the nation does

Australia is rich in natural resources and its early economy was built exclusively around them. Nowadays, although primary products and commodities still earn much of the country's foreign exchange, a far smaller proportion of the workforce is engaged in working to extract them. Instead, the service industries have increased greatly in importance (see Table 2.7 and Fig. 2.18).

Much employment and economic activity in Australia takes place in what are classified as small to medium business enterprises. These are particularly important in the areas of construction, community services, retail trade, transport and storage, property and business services and recreation and personal services.

Services and manufacturing

The three main areas of private-sector industry in Australia, in terms of numbers of people employed, are wholesale and retail trade, manufacturing and the joint category of finance, property and business services. These were also the three top contributors to the gross domestic product. Over the last few decades, the broad category of service industries has taken over the dominant role in the economy. Agriculture's contribution has declined, and so has that of manufacturing, although the latter still accounts for about 15 per cent of GDP. However, finance, property and business services have nearly doubled their share in the 30 years to 1993. Tourism has become increasingly important — both for employment and as a source of national revenue. International visitors increased nearly threefold (to three million) from 1981 to 1993. As well as being a major earner of foreign currency, tourism clearly has the potential to generate great environmental pressures — especially in certain 'hot spots'.

About 166 000 Australians work in the food, beverage and tobacco industries, making this the largest part of our manufacturing base. Other important areas are machinery and equipment, paper and its products and publishing. New South Wales and Victoria dominate manufacturing, together accounting for two-thirds of manufacturing turnover and employment.

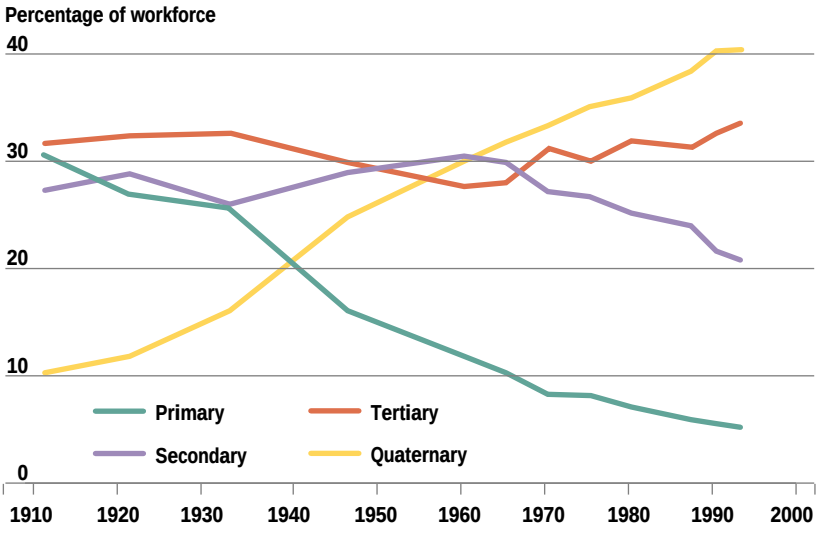
The wholesale industry is dominated by businesses dealing in machinery and equipment, and minerals, metals and chemicals. Computer wholesaling has grown greatly and is now an important part of the machinery and equipment category. The retail sector is dominated by supermarkets, grocery stores, department stores and specialised food-retailing.

Table 2.7 Australian exports of goods and services at current prices

	($ million) 1987–88	1992–93
Rural Exports (f.o.b.)		
Meat and meat preparations	2 557	3 752
Cereal grains and cereal preparations	2 298	2 953
Sugar, sugar preparations and honey	701	1 073
Wool and sheepskins	5 806	3 365
Other rural	3 979	5 936
Total rural	**15 341**	**17 079**
Non-rural exports (f.o.b.)		
Metal ores and minerals	5 480	7 942
Coal, coke and briquettes	4 866	7 620
Other mineral fuels	1 786	3 913
Gold	3 107	4 583
Other metals	3 863	5 211
Machinery	1 836	4 347
Transport equipment	1 022	2 020
Other manufactures	3 006	6 017
Other non-rural	1 208	1 283
Total non-rural	**26 174**	**42 936**
Total exports of goods (f.o.b.)	**41 515**	**60 015**
Exports of services	**9 565**	**14 863**
Total exports of goods and services	**51 080**	**74 878**

Source: compiled from ABS, *Yearbook Australia*, 1995 (Table 26.4).

Figure 2.18 Australian labour force in paid employment, by occupation



Note: Primary sector includes agriculture, forestry, fishing, mining, quarrying and oil extraction. Secondary sector includes manufacturing, building and construction. Tertiary sector covers tangible economic services involving the processing or transfer of matter and/or energy. Quaternary sector covers intangible services such as the processing of information.

Source: Censuses of the population of Australia as cited by B. Jones (1995).

The wholesale and retail trade sector employs about 1.6 million people. Motor-vehicle selling and services are also important, as might be expected in a country that, at the last count, contained 567 private motor vehicles for every 1000 people. Australia is second only to the United States in its rate of car ownership.

Agriculture

Despite the high levels of employment and turnover in the retail, finance and other aspects of the service sector, the primary industries — agriculture and mining — remain important in terms of generating employment in the other sectors of the economy, of export income and of their great potential to affect the natural environment over large areas. Agriculture may not be a big employer any more, but it is certainly our major form of land use, taking up about 60 per cent of the country's area (see Fig. 2.19). Grazing — of cattle, mainly for beef, and of sheep for wool — is the main form of agriculture in terms of dedicated land area. By comparison, conservation reserves take up a little over five per cent of the land area, and forestry about 4.8 per cent. Mining operations take up less than one per cent.

In 1994, Australia supported about 134 million sheep, 25 million cattle and 69 million chickens. Australian agriculture not only feeds the country's human population of 18 million, but also provides sustenance for millions of people in other countries. A rough calculation suggests that our exports feed about 55 million people at Australian levels of consumption. We also produce about one-third of the world's wool. Although its importance to the nation has been declining since earlier this century, wool still contributes about five per cent of our merchandise exports.

Australian agriculture tends to be extensive rather than intensive, characterised by the raising of domesticated animals on outdoor pasture. Stocking rates are low compared with other countries because the quality and quantity of feed tends to be poor as a result of low rainfall and poor soils. Many of our sheep and cattle are grazed in the better-watered mixed-farming zones, with a much smaller proportion in the arid and semi-arid rangelands. Wool and beef are the main products; dairying is now concentrated in the south-east and in irrigated areas in the Murray Valley.

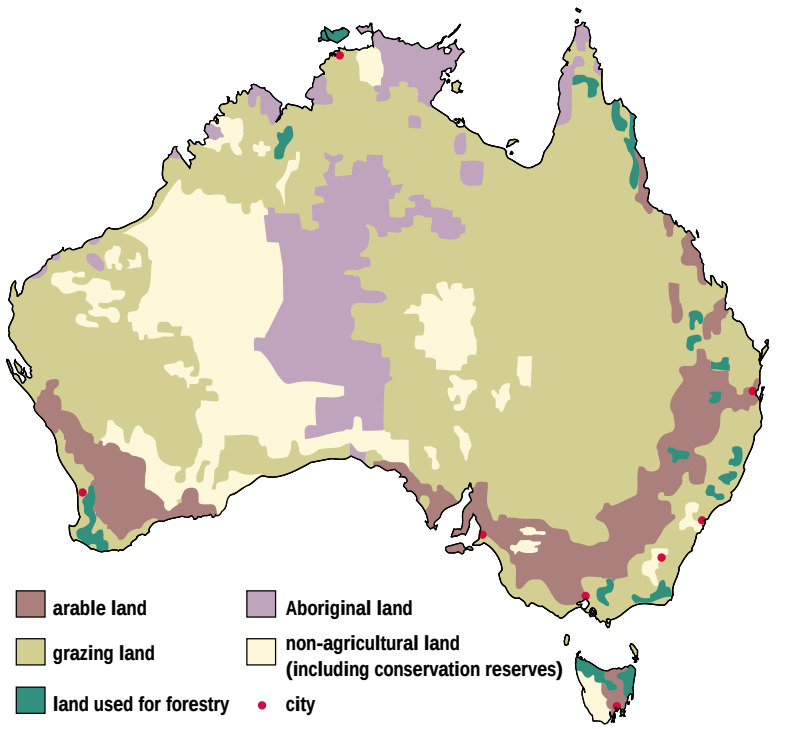
Arable farming is confined to a far smaller area than pastoralism (see Fig. 2.19). Winter cereals (wheat, barley and oats) are the major crops. The wheat belt stretches in an inland ribbon from central Queensland, through New South Wales and Victoria and into part of South Australia. A separate belt occurs in Western Australia in the south-west of the State. Just over 9.5 million hectares of land are devoted to wheat-growing. The other main food crops are sugar cane (confined to the tropics) and rice. In addition, the country produces a wide range of fruit and vegetables. Cotton is the principal non-food crop.

Soil nutrient deficiencies are common and fertilisers, particularly phosphate, are widely used. However, their use is limited over much of the country, where low rainfall limits potential yield and thus the return on fertiliser expenditure. High rates of fertiliser use do occur with irrigated crops and those in humid areas where nutrient run-off may have a potentially serious impact on waterways and coastal zones.

About two million hectares are irrigated. Most water for irrigation comes either from the main river system, the Murray–Darling, or from groundwater aquifers.

The success of the nation's agriculture has come at an environmental price. Land degradation (soil erosion, soil structural decline and salinity) is one of the most serious problems affecting the country's terrestrial environment. Much of the reduction in the biological diversity of the continent has also been driven by the destruction or disturbance of natural habitat and the introduction of non-native species of plants and animals for use in agriculture.

Figure 2.19 Land use in Australia



Source: adapted from AUSMAP Atlas of Australia, 1992.

Minerals

About three-quarters of Australia's mineral production is exported, especially to Japan. The mining industry contributed 4.3 per cent of Australia's GDP in 1992–93. In terms of exports, mining now has more importance to the economy than agriculture.

Australia is the world's largest single producer of bauxite (the ore from which aluminium is refined), accounting for some 38 per cent of the global supply. The country is rich in rare mineral sands,

and again is the world's largest supplier, providing about half of all ilmenite and rutile, and nearly 40 per cent of zircon. In terms of sheer quantity, the major mined products are black coal, iron ore, brown coal and bauxite. In terms of value, coal, gold and iron ore are the most important. Some coal is consumed domestically, as most of Australia's electrical power comes from coal-burning power stations. Gold is now our biggest export earner, having overtaken wool in 1991. Gold-mining is the second largest employer in the mining sector after coal.

Forestry

Apart from treeless Antarctica, Australia in its natural state is the world's least-forested continent. Since European occupation started 200 years ago, the continent's already small stock of forest has been reduced by about 40 per cent. Much of the clearance has occurred to provide land for agriculture and settlement. The total area of native forests remaining is about 41 million hectares. Some 16 per cent of this area stands in national parks or heritage areas, and 27 per cent on private land. The rest is either managed by State forest agencies, or lies on vacant or leased Crown land. The area of plantations is growing and now covers some one million hectares. Most of these plantations comprise exotic species of pine, although the area of native hardwood and softwood plantations is also increasing.

Forests are managed for a variety of sometimes competing uses. The timber industry is an important employer in certain parts of the country. Australia produces nearly 70 per cent of its sawn-timber needs, and some of its own paper products. It exports woodchips, paper and paperboard products. But, in terms of value, it imports more forest products — mainly as paper and sawn timber — than it exports.

Fisheries

Fishing has developed rapidly since the 1950s, with a dramatic rise in the tonnage caught. Large quantities of crustaceans and molluscs (such as lobsters, prawns, abalone and scallops) are taken, mainly for export. While most finfish are caught for domestic consumption, increasingly more of the catch is exported. The main finfish caught are tuna species for export markets and some domestic consumption. The south-east trawler fleet catches species such as whiting, gemfish, morwong and orange roughy, a deep-dwelling bottom fish. Aquaculture is a growing industry.

From 1984 to 1990, Australian consumption of seafood rose from 6.3 kg to 7.9 kg per person per year (about 60 per cent of this was imported). The fishing industry is Australia's fifth-largest primary industry exporter and over the period 1987–88 to 1989–90 seafoods comprised four per cent of the value of primary product exports. In 1992 the Industry Commission found that most Commonwealth fisheries were over-fished and over-capitalised.

Tandala, Aboriginal Culture Centre, Adelaide; tens of thousands of years of continuous human settlement have left a rich legacy of culture and history.

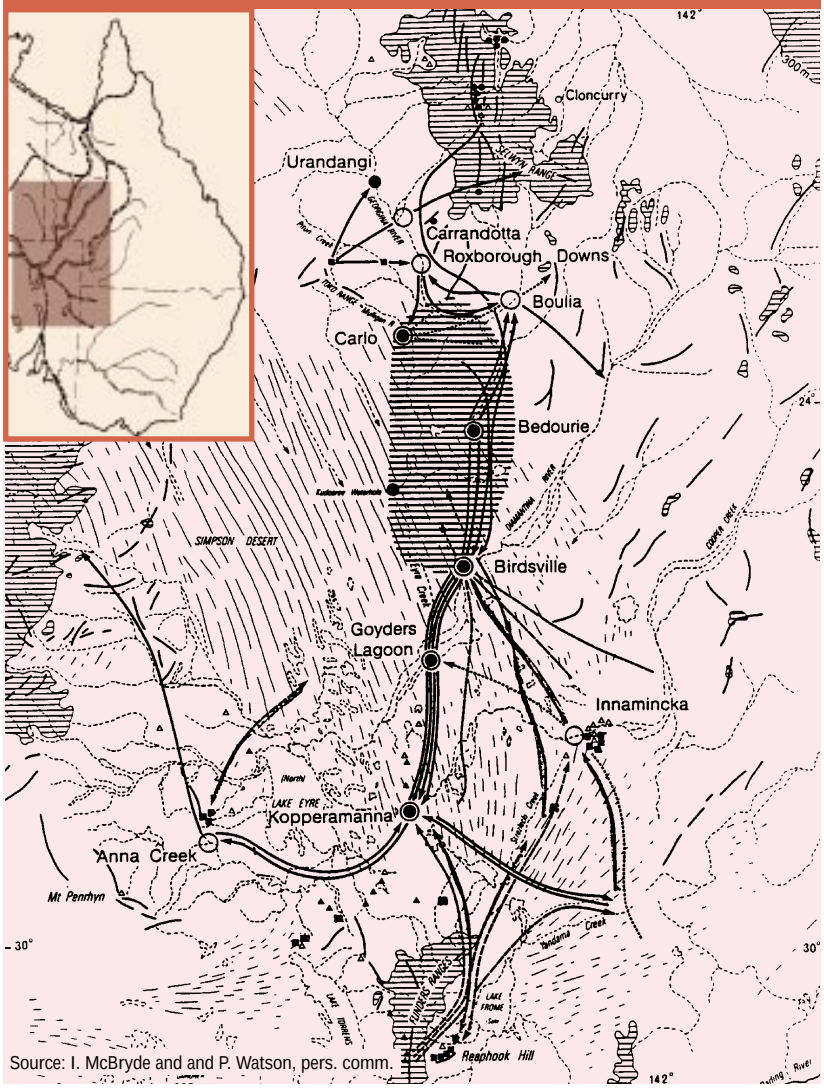
A rich human heritage

On top of its unique natural heritage, tens of thousands of years of continuous human settlement have left a rich legacy of culture and history in Australia. But the early European settlers (with their own religious and social beliefs) found Aboriginal cultures and languages quite alien, difficult to understand and irrelevant to them and so tended to ignore or deliberately destroy them. As a result, much of Australia's original cultures — especially those based on oral tradition — have been lost. But some remains, and is being built on, continuing in strong contemporary forms today. As well, traditions brought to the continent by other peoples over the last two centuries have taken root. At their best, the various cultures and traditions together make a total sum of distinctive human and cultural heritage that is as important and as recognisable a part of Australia's environment as kangaroos or gum trees.

When the European colonisation of Australia started in 1788, the country was inhabited by an unknown number of Aboriginal peoples organised into social groups that covered the whole continent and the islands of the Torres Strait. Literally hundreds of complex, intricate languages, as distinct as the different languages of Europe, were spoken and traditional legal systems operated. Exchange networks were long established across the continent — they linked distant societies in alliances that were social and ceremonial as well as serving as trade routes. The exchange networks of eastern central Australia are amongst the most extensive known from small-scale, non-urban, non-industrialised societies and attest to the cultural achievements and sophistication of Australia's prehistoric societies (see Fig. 2.20). Most of the linguistic and cultural diversity has now been lost, especially in the southern part of Australia, as the Aboriginal peoples died in large numbers (often from introduced diseases to which they had no resistance), moved or were removed from their land or were integrated — forcibly or otherwise — into European culture.

The great majority of original Australian languages have become extinct, or are becoming so — existing with only a few elder speakers. The death of a language is the loss of something unique and

Figure 2.20 Exchange networks of the Lake Eyre Basin before European settlement



Source: I. McBryde and and P. Watson, pers. comm.

irreplaceable, and is also an indicator of the loss of cultural heritage. But some elements of the original Australian culture, adapted to modern life, remain in certain areas still inhabited by the traditional owners, and some have been adopted, albeit in token or modified form, into the mainstream identity of Australia. Since the Bicentennial in 1988, the cultural heritage of Aboriginal and Torres Strait Islander peoples has been recognised more widely. Some Aboriginal languages are still spoken, and a few — such as Pitjantjatjarra — have even increased their area of coverage, becoming a 'lingua franca' for central Australian Aboriginal peoples. Aboriginal languages have also given us many Australian place names and unique words in Australian English.

The great post-war immigration wave has continued, bringing many languages, along with cultural traditions from many parts of the world. In 1947, more than 90 per cent of Australians had been born here. Today, nearly one-quarter of the population was born overseas. The range of countries from which migrants come has been increasing in line with changes to immigration policy. Australia is now truly a multicultural society.

Managing our environment

Human impacts

Humans have interacted with the natural environment in Australia for tens of thousands of years and have brought about changes as a result. But in the last 200 years the pace of change has accelerated dramatically. Now much of the natural environment — not to mention the original cultural environment — is irreversibly altered.

The environment that so amazed and then dismayed the first European explorers and settlers in Australia — and which in the recent past had been thought of as 'pristine' — was clearly affected by an earlier human presence. However, the extent and seriousness of the impact is the subject of debate. As we do not know the total population of the continent when Europeans first came, or the population densities that possibly occurred in certain highly settled areas, it is hard to determine the scale of pressure on the environment at that time.

Aboriginal hunting may have affected the numbers of certain animals. Early explorers' reports indicate that some species of edible wildlife (such as kangaroos, wallabies, koalas, possums, bandicoots. as well as brolgas, swans and ducks) were nowhere as abundant as they became subsequently. Some animals, such as the red kangaroo, benefited from land clearing, planting of crops and the provision of water for stock in the outback by European settlers. The original inhabitants also affected the vegetation, probably reducing forest cover in places.

The first Australians are thought to have possessed raft- or canoe-building skills in order to reach the country, and a detailed knowledge of fire and its effects. Aboriginal people at the time of European arrival used fire to manage their land. It had the dual purpose of stimulating seed-setting and germination, and of driving out game animals or attracting large marsupial grazers to areas of new shoots. Continuous, regular burning must have modified vegetation patterns and species compositions in many parts of the country. Areas that now support forest and woodland were grassy open woodland with widely spaced trees 200 years ago (according to the descriptions and paintings of the time). These changes have occurred almost certainly as the result of the decline in regular burning. Aboriginal peoples built fish traps in rivers and on the coast, which could also have had environmental effects.

Whether any extinctions can be attributed to the first Australians is a matter of scientific debate — the evidence remains circumstantial. About 40 species of marsupials (mainly very large ones) became extinct after the arrival of people, and by 20 000 years ago few mammals survived that were larger in weight than the by-then-widespread human predators. The later arrival (about 3000 years ago) of the dingo, possibly brought by voyagers from South-East Asia, must have had effects too. Some would argue that the competition from the dingo led to the extinction of the larger marsupial carnivores, the thylacine and the Tasmanian devil on the mainland. Dingoes did not

Australia 1970

Die wild country, like the eaglehawk,
dangerous till the last breath's gone,
clawing and striking. Die
cursing your captor through a raging eye.

Die like the tigersnake
that hisses such pure hatred from its pain
as fills the killer's dreams
with fear like suicide's invading stain.

Suffer, wild country, like the ironwood
that gaps the dozer-blade.
I see your living soil ebb with the tree
to naked poverty.

Die like the soldier-ant
mindless and faithful to your million years.
Though we corrupt you with our torturing mind,
stay obstinate; stay blind.

For we are conquerors and self-poisoners
more than scorpion or snake
and dying of the venoms that we make
even while you die of us.

I praise the scoring drought, the flying dust,
the drying creek, the furious animal,
that they oppose us still;
that we are ruined by the thing we kill.

By Judith Wright (1915–)
In *The Collins Book of Australian Poetry*.
(Chosen by Rodney Hall. Collins, Sydney,1981).
Reproduced with permission of Harper Collins Publishers.

reach Tasmania because by then it was separated from the mainland by a wide sea barrier — Bass Strait. The thylacine survived in Tasmania until the 1930s.

The original inhabitants of Australia altered the biophysical environment in more subtle ways than we do today. Whatever their impacts, their continued survival showed that they must have lived sustainably within the resources of the continent for tens of thousand of years.

Of far greater import were the effects of the settlers from 1788 onwards, who were responsible for:

- introducing and spreading agriculture
- introducing exotic plants and animals
- widespread change of land cover (by deforestation/clearing and ringbarking)
- changing fire regimes
- introducing land use practices suited to Europe
- commercial hunting for hides, skins, plumes and blubber oil
- large-scale mining
- urbanisation
- industrialisation

Patch burning in Uluru National Park as a management technique follows traditional Aboriginal practice (top).

The giant herbivore, *Diprotodon optatum* (right) was one of about 40 species of marsupials that became extinct after people arrived in Australia.

The broad categories of effect from these actions are:

- land degradation
- loss of biodiversity
- depletion and/or modification of water resources
- air and water pollution and soil contamination
- changes to the coastal and marine environment

In addition, humans now impose a pressure on the various environments that they have created for themselves.

Environmental management

Environmental management in Australia is guided by the 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.

The environment itself does not respect the borderlines that humans draw — whether these be national, administrative or intellectual boundaries. But the fragmentation, and sometimes duplication, of society's decision-making processes contradict the nature of environmental issues themselves. Thus the structure, organisation and functioning of Australian society and government are themselves key factors, and sometimes pressures, affecting the environment.

Although government in various forms is responsible for much of what is generally called management, many other groups in society — and especially the everyday decisions of millions of individuals — play important roles when it comes to affecting the environment.

Individuals and the community

In recent years, opinion polls have consistently shown that environmental issues are high on the list of concerns for most Australians. The Australian Bureau of Statistics has found that between 1986 and 1994 the number of people expressing concern for the environment had increased by 20 per cent to 70 per cent. Community interest in global environmental issues, and in the response of governments at all levels to those issues, is also high.

Across the country, many environment and conservation organisations exist, with hundreds of thousands of members collectively. Most of their resources come from public donations although a number receive some funds from the Commonwealth Government.

And, when multiplied millions of times, the behaviour of individuals — choosing to use phosphate-free detergent, conserving water in the garden, recycling household paper, or reducing energy consumption — can be significant. Most Australians make these everyday, small 'environmental management' decisions. Little coordination of this takes place, beyond single-issue campaigns conducted by government and other organisations, and the dissemination of factual information, of which this report forms a part.

Major environmental issues in Australia's offshore territories

Territory	Main Environmental Issues	Comments
Ashmore and Cartier Islands	Protection of Ashmore Reef National Nature Reserve	The Australian Nature Conservation Agency maintains a presence during the fishing season to protect wildlife and monitor Indonesian traditional fishing activities as well as the activities of any other visitors.
	Oil/gas developments in Bonaparte Basin	Aerial surveillance flights monitor the potential threat of pollution drifting from the adjacent fields to the Territory. No such pollution has as yet escaped from the fields.
Norfolk Island	Conservation of the Kingston/Arthur's Vale Historic Area	The Commonwealth and the local government provide ongoing financial support for the conservation and restoration of this Historic Area, which contains the finest collection of colonial Georgian architecture in Australia and is listed on the Register of the National Estate.
	Protection of the Island's National Park and endangered species	The Australian Nature Conservation Agency administers the National Park which is being extended to include Phillip Island. The Agency also manages 3 endangered species recovery programs for the Island's green parrot, morepork owl and a composite program for some 40 threatened plant species.
Cocos (Keeling) Islands	Protection of the Cocos Atoll including North Keeling Island	North Keeling Island is listed on the Register of the National Estate. The Island is an important major breeding ground for sea birds that are protected under various international treaties. Because of this and the fact that it includes the last significant remnants of Cocos Islands' original vegetation, the island is presently in the process of being declared a national park.
Coral Sea Islands Territory	Protection of Lihou Reef and Coringa-Herald National Nature Reserves	The Australian Nature Conservation Agency patrols the reserves with assistance from the Royal Australian Navy and Coastwatch and conducts wildlife management programs. Permits are required for camping, for conducting scientific research and for any commercial activity including fishing or diving charters.
Christmas Island	Protection of Christmas Island National Park and endangered species	Christmas Island's isolation has resulted in a unique ecological environment attracting its own bird species such as the endangered Abbot's booby. Much of the island's original rainforest remains intact which enhances the survival of the species and other rare plant and animal life.

Note:
Australian Antarctic Territory and the Territory of Heard Island and McDonald Islands are not included.

Source: DEST, Office of Territories, unpublished data.

Industry and commerce

Australia's manufacturing and industrial base plays a crucial role in the life of the nation. The private sector provides a high proportion of jobs, as well as goods and services. Increasingly, businesses are becoming aware of the importance of environmental matters, and their accounting includes expenses related to responsible environmental behaviour.

Companies consider environmental management for a range of reasons: they may be pragmatic — not wishing to fall foul of the relatively new environmental laws and regulations ranging from control of emissions and toxic-waste disposal to rehabilitation of mined areas; they may see that environmental auditing and management are good for business public relations; or it may make good economic sense. This has been stimulated by the recent rise in green consumerism in Australia and throughout much of the Western world. Many businesses realise that adopting cleaner production through better use of resources and waste minimisation enables them to save money. Others may quite simply be motivated by an environmental concern that goes beyond the economic rationalism of the short-term 'bottom-line'.

Many sectors of business have highly developed environmental divisions, which have existed for decades, but other areas still remain relatively unconcerned about the environment. However, in general the business sector's awareness of environmental matters and of its responsibilities has seen a rapid upturn.

The increasing importance of environmental management, monitoring and pollution control present considerable business opportunities. Australia already exports both expertise and hardware in these fields.

Government

Australia is a democratic, politically stable country headed by a constitutional monarch, with several spheres of government. These are the Commonwealth, State, Territory, and local governments. However, in certain areas, the traditional law- and decision-making processes of Aboriginal and Torres Strait Islander peoples continue — and the significance of this has recently been strengthened by the High Court's decision on the Mabo case concerning the traditional ownership of land. Beyond government in Australia lies the international community, in which Australia participates through its membership of many world bodies, through being a party to agreements, treaties and protocols, and by being accountable through the mechanism of the World Court.

The nation known as the Commonwealth of Australia came into existence in 1901 following the federation of six separate British colonies (the forerunners of the present States). An important issue in the debate that led up to Federation was the extent of conflicts between the colonies — notably trade and defence, although some related to resource-use issues, in particular the Murray–Darling river system. The Constitution formulated at Federation defined the powers of the Commonwealth Government, which are designed to encompass matters relating to the country as a whole. These include defence, external affairs, banking, immigration, trade and commerce, taxation, posts and telecommunications and social welfare. Since Federation, various powers, in particular those set out in section 51 of the Constitution, have become particularly relevant to implementing the Commonwealth's environmental responsibilities, especially since 1970, including the following:

Parliament House Canberra; the Commonwealth has substantial powers to enact laws affecting the environment and sustainable development.

- the conduct of external affairs (in particular the signing of certain international treaties and agreements that require actions within Australia)
- taxation and the power to grant financial assistance (with conditions) to State and Territory Governments
- the 'corporations power' whereby the Commonwealth can impose various conditions on corporations concerning the management of their land
- the management of fisheries throughout Australia's exclusive economic zone
- the issuing of export licences for major resource developments
- quarantine across the whole country
- Aboriginal and Torres Strait Islander affairs

Thus, the Commonwealth Government relies on a wide variety of powers to give effect to its policies.

Australia has about 770 local governments, which are responsible for the provision of local services such as environmental health regulation, road building and maintenance, municipal waste management, land use planning and development control, pollution control and monitoring, traffic management, parks and open space, recreation facilities and community services.

Watching the world's heritage

One of the most 'high-profile' of the environmentally relevant international treaty agreements that Australia has entered into is the UNESCO World Heritage Convention of 1972, which was ratified in Australia in 1974 and came into force in 1975. The aim of the Convention is to protect, anywhere in the world, natural and/or cultural heritage of such outstanding universal value that its conservation is of concern to all people. Places on the World Heritage List should be conserved for all time.

Member countries must ensure that they identify, protect, conserve and present their listed World Heritage properties. The 11 World Heritage properties in Australia, as of June 1995, are listed in Chapter 9.

The Australian Constitution does not specifically deal with environmental powers and they are not the sole province of any one sphere of government. Most environmental legislative responsibilities rest with the State and Territory Governments although the Commonwealth does have substantial powers to enact laws affecting the environment and sustainable development. In some cases, the High Court has tested and confirmed these powers. However, many day-to-day government decisions that affect the environment occur at the level of local government. The interconnectedness of the environment means that very few aspects can be managed solely by one sphere of government, or one agency, in isolation from other spheres and agencies; and no aspect of the environment can be managed in isolation from the community. And plenty of other environmentally relevant decisions neither involve nor emanate from governments at all, but rather are taken by industry, various special-interest groups and individuals acting alone or collectively.

Various means of overcoming the existing fragmentation in the way we view and respond to the environment are in place, both nationally and internationally. These are briefly touched upon below.

National environmental management and policy-making

The national processes to help provide a more holistic form of environmental management can be classified into the following eight categories.

- *The Council of Australian Governments (COAG),* composed of the Prime Minister and the leaders of the States and Territories and local government, is the peak body overseeing closer cooperation between Australian Governments on issues concerning clarification of roles and responsibilities in areas of shared responsibility, micro-economic reform, regulation and the environment. Among COAG's first tasks when it was established in 1992 was overseeing the finalisation of the InterGovernmental Agreement on the Environment (IGAE) and the National Strategy for Ecologically Sustainable Development.
- *Ministerial councils and their advisory groups* involve Commonwealth, State and Territory ministers responsible for various common matters meeting together regularly. There are many such councils relevant to the environment.
- *National inquiries* are initiated at the political level by Parliament, by governments, by individual ministers, or by ministerial councils. At their best, inquiries can be multidisciplinary in scope, and can pull together information from different jurisdictions and sections of the community. In this way they can arrive at a point of view dictated by the region or phenomenon under investigation rather than emanating from particular sectors.
- *The InterGovernmental Agreement on the Environment* was agreed to in 1992. It was designed to avoid damaging disputes about environmental matters between the different levels of government in the country. It establishes conditions under which Australia's various governments will interact and includes a set of principles to guide the development of environment policies.
- *National strategies* include the National Strategies for Ecologically Sustainable Development, Greenhouse Response and Biodiversity as well as various sectoral strategies. Their development involves consideration by all spheres of government and consultation with industry and the community. When adopted, all governments, at least in theory, use national strategies to guide their decision making.
- *Strategic arrangements for management on a drainage basin or ecosystem basis* are exemplified by the Murray–Darling Basin Commission. The river catchment that it manages straddles four States and one Territory. It has been estimated that 33 different government departments have some responsibility for the river system, and 268 local governments have a stake in it. Countless land-owners and farmers use the water or have an effect on it. The Great Barrier Reef Marine Park Authority and the Wet Tropics Management Authority are other good examples.
- *Commonwealth legislation* is the only way some aspects of environmental management can be consistently governed throughout Australia; for example the *Wildlife Protection (Regulation of Exports and Imports) Act 1982*, the *Antarctic Marine Living Resources Conservation Act 1981*, the *Hazardous Waste (Regulation of Exports and Imports) Act 1989* and the *World Heritage Properties Conservation Act 1983*.

- *Complementary legislation* is legislation mirrored in each jurisdiction to ensure a national approach; for example the legislation establishing the National Environmental Protection Council.

Other functions of government

The work of modern government is too complex and intricate to detail here. Suffice it to say that the Commonwealth, State and Territory Governments maintain various departments that deal with a range of matters related to the environment. The names and precise divisions of responsibility between departments frequently change in response to political agendas.

International perspectives

Certain aspects of the natural environment, such as migratory species and water or atmospheric pollutants, although they may originate in a particular country, cannot be contained by any human boundaries. Other features, like the open ocean or the atmosphere, are 'common goods' that do not belong, in the legal sense, to any single nation. International agreements regulate certain human activities, such as air and sea transport, high-seas fishing and human uses of the Antarctic region. As a result of the interconnectedness of so much of the natural environment and international human activity, many environmental problems — for example, the enhanced greenhouse effect or over-exploitation of oceanic resources — require global action if we are to have any hope of solving them.

Since the 1940s, the pace and breadth of human activities affecting the global environment have increased greatly; and so too have awareness of and concern for our environment. Over the last few decades it has become clear that there is a need for international agreements to preserve many places (such as Antarctica) or regulate activities (such as whaling) for the benefit of all nations or for the sake of other species or unique natural environments.

The world has responded to the increase in human pressures and to the growing realisation of the 'wholeness' of nature by creating many international organisations, treaties, conventions and agreements in an effort to deal with issues that transcend national boundaries.

Australia participates in the international community and contributes to the global effort to manage the planet. It is a party to one of the world's earliest environmental treaties, the Antarctic Treaty of 1959, which designates Antarctica as an area to be used for peaceful purposes only. A number of international agreements now involve Australia in global environmental issues, such as the enhanced greenhouse effect, ozone depletion in the stratosphere and the trade in endangered species. Appendix 1 includes a full list.

Between 1990 and 1992 the United Nations developed a global action plan for sustainable development. The United Nations Conference on Environment and Development, also called the 'Earth Summit', in Rio de Janeiro in June 1992 adopted this plan — Agenda 21. The Conference also saw the signing of two new global Conventions — on Climate Change and on Biological Diversity — the signing of a statement of principles for forest management and the adoption of a declaration on the principles of sustainable development ('The Rio Declaration'). Agenda 21 sets out actions that nations, communities and international organisations can all take to help achieve the goal of global sustainability in the 21st century. The Conference also led to the establishment of a new United Nations organisation, the Commission on Sustainable Development, which meets annually to review progress in the implementation of Agenda 21.

The environment is now firmly on the international political agenda and is the subject of negotiation and discussion in many forums. The aim of all these activities is to protect the environment and conserve natural resources thereby enhancing human well-being and development and the security of nations. The institutions we design to monitor and protect the environment will themselves be complex and imperfect. This is because the environment includes everything and everyone, the impacts of human activity can be so far-reaching, and the world is divided into nations and regions with different aspirations.

Conclusion

Australia has a distinctive environment and heritage. Its biological diversity is special in global terms. Its climate and rainfall constrain people's activities. Its cultural landscapes are of great antiquity. The broad spatial distribution of its population has energy usage implications.

How well is Australia managing its environment as we near the end of the 20th century? How can community, industry and government be empowered to make decisions that protect the future environment and heritage of Australians? State of the environment reporting is a tool to provide a broad picture of the Australian situation. Such reporting, including monitoring of environmental indicators, provides the facts needed now by all decision-makers in the move to a more ecologically sustainable society.

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