

3

Australian biomes





Before you start

Main focus

This chapter will examine a range of Australia's biomes and how they have evolved to fit into Australian environment.

Why it's relevant to us

The sale of Australia's resources – food and minerals – is a major source of income for the nation but it comes at a cost to the country's biomes.

Inquiry questions

- What are Australia's biomes?
- What factors influence the location of these biomes?
- How have humans impacted on these biomes?

Key terms

- adaptation
- biome
- deciduous
- desert
- ocean currents
- pneumatophores
- rainforest
- scale
- temperate
- torrid
- xeric

Let's begin

Australia has developed a unique set of biomes because of its isolation from other continents for millions of years. As the Australian continent has drifted northwards over these millions of years, the flora and fauna which make up the biomes have adapted to the changing environment. At times large parts of the current continent were the floors of shallow seas, and at times the climate was very different. A completely different set of biomes existed in places that are now desert or semi-desert. Today's biomes are a result of climatic and altitudinal factors discussed in Chapter 2. Other local factors, together with the role of humans in the mechanics of a biome, will be discussed in this chapter.

Australia's biomes using the geography concept of 'scale'

The examination of world biomes in Chapter 2 identified 5 biomes in Australia:

temperate zone broad climate zone between tropics and poles

deciduous trees that drop their leaves each year, typically for winter

scale (on a map) the amount by which the real world has been reduced so that it fits onto the map

- tropical rainforest
- tropical seasonal forest/savanna
- **temperate deciduous** forest
- subtropical desert
- woodland/shrubland.

Chapter 2's examination of biomes was based on a map of the world with a very small **scale**. Small-scale maps can only show a certain amount

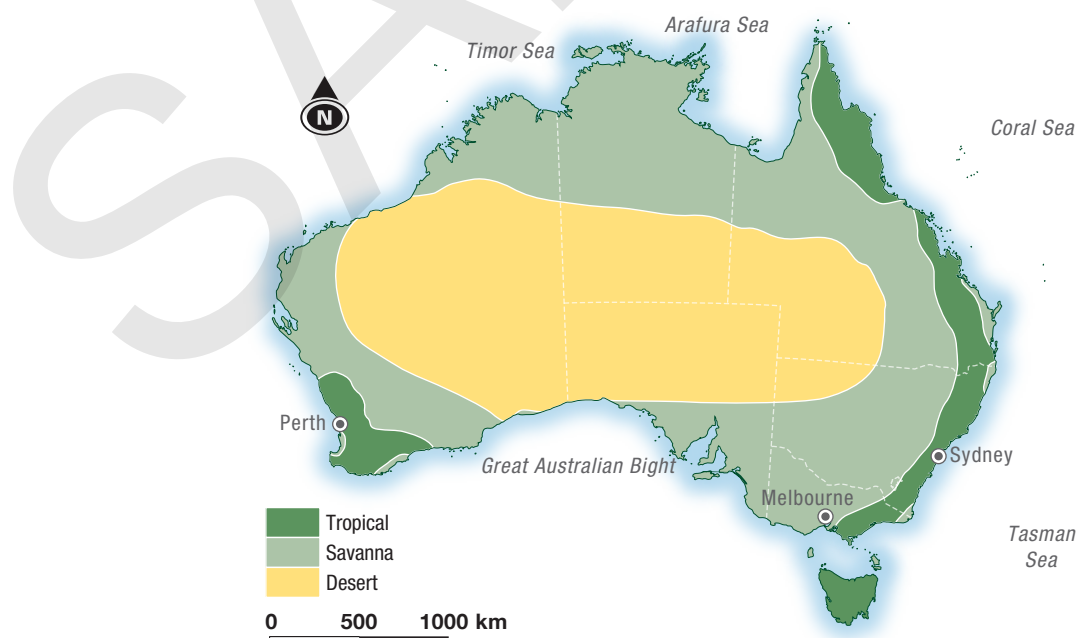
of detail. The focus is now on the biomes found in Australia. This requires study at a much larger scale, where more detail can be shown.

Here are two figures representing Australia's biomes. Which is better?

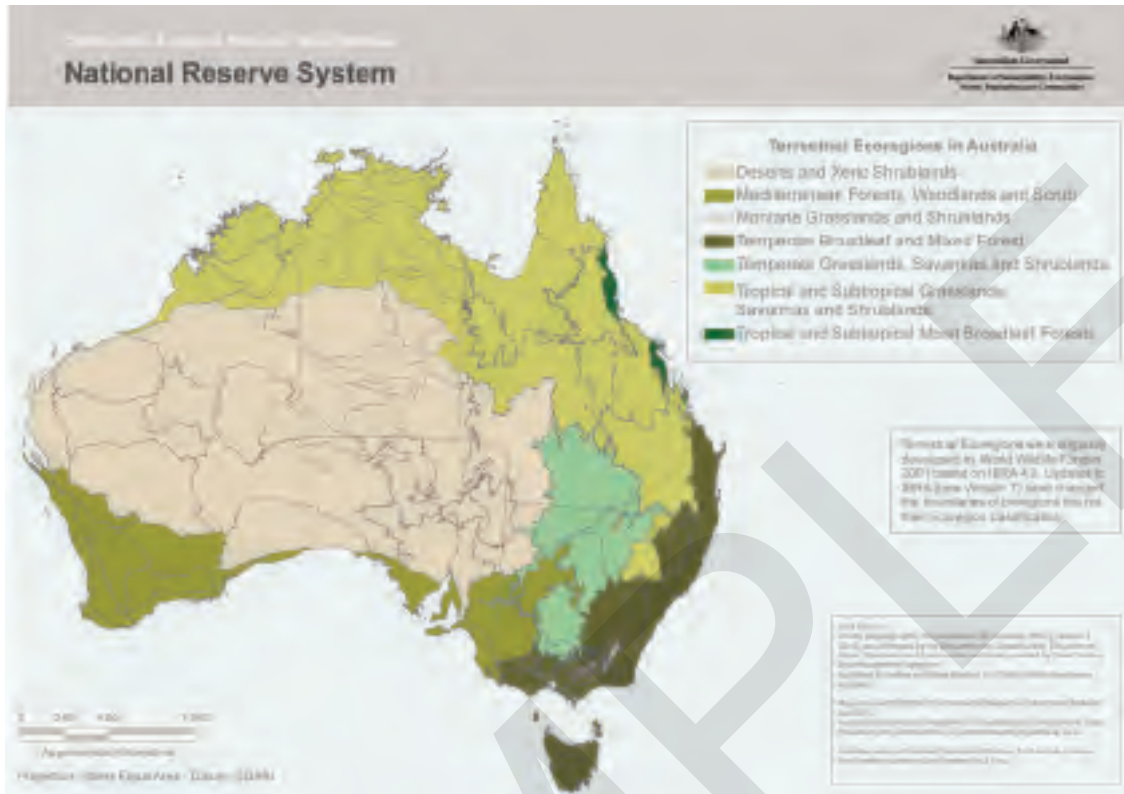
Source 3.2 is simple and uses the terms used in Chapter 2. Source 3.3 is more complicated. There are more biomes identified, and they have more complicated names.

It is like thinking of the world's population. There are two types of people – males and females. That is much like Source 3.2. But just think how many types of people those men and women could be divided into. That is more like Source 3.3. The task here is not to divide the world's population into different classifications, though; it is to look at the best way of examining Australia's biomes.

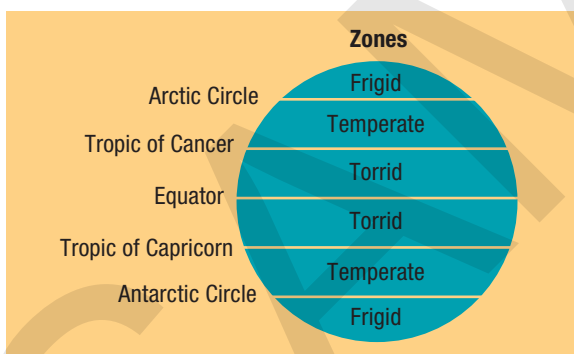
If Source 3.2 is used, it is clear that the study would be very general. Another issue with Source 3.2 is the terminology. The terms 'desert' and 'savanna' are fine, but defining the rest of Australia as 'tropical' is a problem. Perth, Hobart and Sydney are all in 'tropical' areas. Even Aristotle, who divided the world up into climate zones hundreds of years before Koppen, would not have considered these cities as being in 'tropical' areas. Aristotle's **torrid hot and dry** idea of 'torrid' is now referred to as 'tropical'. Aristotle lived from 384–322 BCE, and of course had no idea of the existence of Australia or Antarctica.



Source 3.2 Australia's biomes



Source 3.3 Australia's biomes



Source 3.4 Aristotle's world climate zones

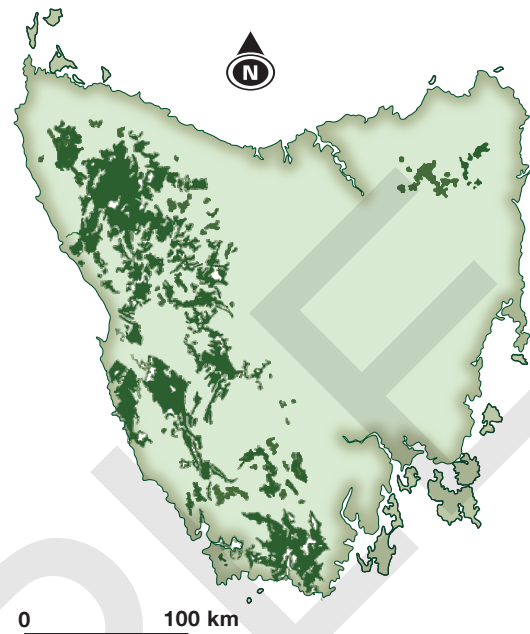
Source 3.3 identifies 7 biomes on the Australian continent. There are some broad links to the biomes identified in Chapter 2. Let's revisit these:

World biome	Australian biome
Tropical rainforest	Tropical and subtropical moist broadleaf forests
Tropical seasonal forest/savanna	Tropical and subtropical grasslands, savanna and shrubland
Temperate deciduous forest	Temperate broadleaf and mixed forest
Woodland/shrubland	Mediterranean forests, woodland and scrub
Subtropical desert	Deserts and xeric shrublands

xeric extremely dry, or adapted to extremely dry conditions

It is immediately clear that there are also differences. When biomes are examined at this scale, there are more biomes, and the biomes are more likely to include more than one vegetation type, such as 'savanna and shrubland', 'deserts and xeric shrublands'. Where do the terms 'broadleaf, Mediterranean and xeric' come from and what is a 'mixed' forest? Follow these up to find their meanings.

These issues simply relate to the scale at which a study is being undertaken: a global study of biomes is made at a very small scale but a study of biomes in Australia can be made at a larger scale. Eventually if the focus was like zooming in with Google Earth, the scale would be so large that it would no longer be a study of biomes but a study of ecosystems.



Source 3.5 Tasmanian rainforest areas

Distinctive Australian biomes

Rainforests

Rainforests are tourist magnets. It is interesting to look at maps of Australia and see where there are areas of rainforest. Source 3.2 makes it look as if the 'tropical' biome extends right down the east coast of Australia to Tasmania and across to Western Australia.

The issue is complex. How do you define 'rainforest'? Is it simply that the area is wet and has a forest cover? Or is it more than that?

There is clearly a problem with the definition of 'rainforest'. Is the term being used to describe any type of forest found in a wet area? Is it the amount of rainfall or the characteristics of the vegetation which define the biome? A 'rainforest', according to climate definitions, has to have an annual rainfall of more than 4000mm.



Source 3.6 Tasmanian rainforest

RESEARCH 3.1

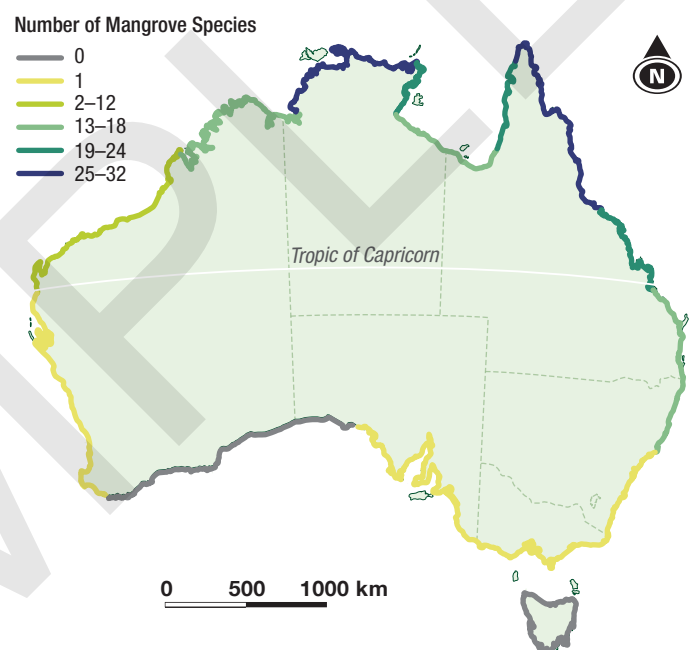
Make a list of the features of a rainforest identified in Chapter 2. Use the list to examine the image of a Tasmanian rainforest in Source 3.6.

- How many features of a rainforest can be seen in the photo?
- Which features in the image are not on the list of rainforest features?
- What difference would it make if the descriptive words were 'vine forest' rather than 'rainforest'?

Many vegetation geographers or biogeographers prefer the term 'vine forest' for the forests of north Queensland, as it is an indicator of the type of vegetation. However, the term 'rainforest' is very well known and will probably remain. It is worth knowing that there are different ideas about rainforests around the world.

Mangrove forests

Mangrove communities are a very distinctive biome worldwide but they don't make it onto the small-scale maps because the communities are found on narrow stretches of coastline. Source 3.7 shows the distribution of mangroves around the Australian coastline. It provides a few ideas on what factors affect the distribution of mangroves.



Source 3.7 Australia's mangrove communities

ACTIVITY 3.1

Identify the following statements as either TRUE or FALSE:

- 1 Mangroves are found right around the coast of Australia.
- 2 Only one species of mangrove is found south of the Tropic of Capricorn.
- 3 Queensland has more mangrove species than New South Wales.
- 4 There are no mangrove species in Tasmania.
- 5 Mangroves are a tropical plant.



Source 3.8 Mangrove community at Hays Inlet, off Moreton Bay, Queensland

Source 3.8 shows part of the mangrove community found around the shores of Moreton Bay. If you holiday at Surfers Paradise, you will not see mangroves growing on the beaches there. The coastline is too active, as it is open to strong wind and wave action.

There are no mangroves on the western side of the Great Australian Bight because it is a long stretch of coastline with few bays and the waters are too rough for mangroves to establish there. There are no mangroves in Tasmania because the temperatures are too low even for *Avicennia marina*, the one species of mangrove which can tolerate cooler waters.

Mangroves grow in quite calm salty waters. They are very similar to rainforests.

Source 3.10 Hays Inlet mangrove community



Source 3.9 The Great Australian Bight, where sand dunes and limestone cliffs face the relentless swells of the Southern Ocean and no mangroves are found

Mangroves are very dense communities, and many have a closed canopy. This cuts out light to the lower layers so that there is no competition from various other species. The mangrove communities drop a lot of litter – leaves and branches – and this decays and provides plant nutrients. The lower layer is usually made up of young seedlings waiting their turn to fill a gap in the canopy. Like the trees in a rainforest, mangrove plants have many **adaptations** which help them survive in their difficult environment: Source 3.11 shows the buttress roots of Queensland's Red Mangrove, which helps support the plant in this muddy environment, and Source 3.12 shows the

adaptation an evolutionary trait a plant or animal develops to better suit its environment

Source 3.11 Buttress roots of the Red Mangrove in north Queensland





Source 3.12 Breathing roots of the *Avicennia marina* (Gray Mangrove)



Source 3.13 Mangrove roots extend into Deception Bay and trap more silt and mud.

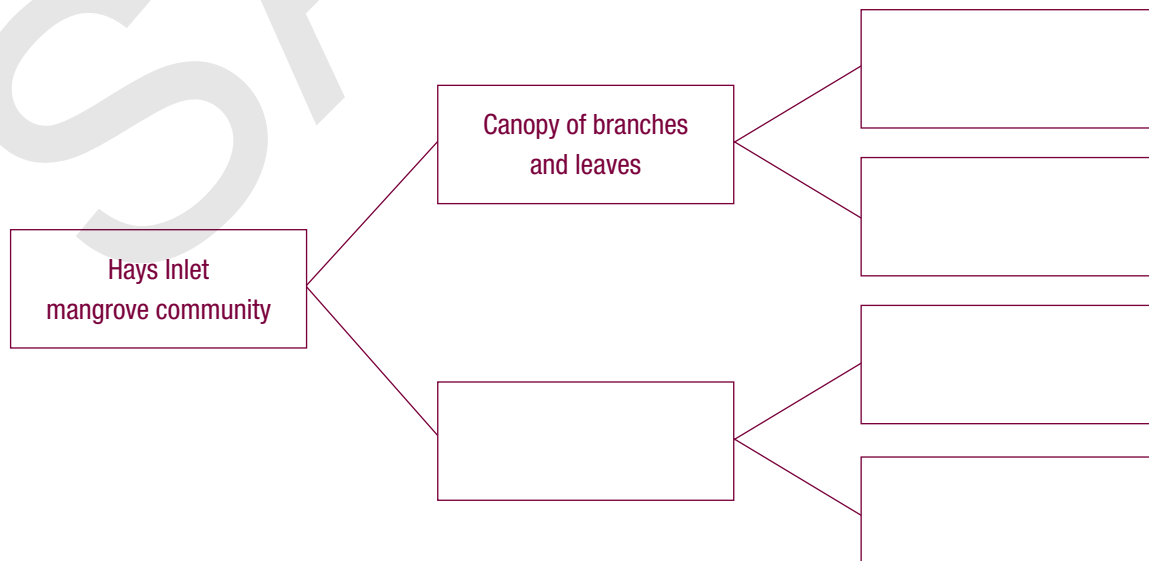
special root system that many mangrove plants have developed. These are breathing roots, which assist as the tide comes in and eventually covers the root system completely. These roots are known as **pneumatophores**.

Source 3.12 also shows another important feature of the mangrove plant. The root system traps silt and mud and builds the land up. Source 3.13, taken in Deception Bay, Queensland, shows the mangrove root systems extending into the bay and building the land up.

pneumatophore a 'breathing root' that helps mangroves survive

>>> **NOTE THIS DOWN**

Copy the graphic organiser below and use the list of rainforest features you noted in Research 3.1, and Sources 3.10–3.14, to explore the Hays Inlet mangrove community.



As the land is built up, the environment changes. The land is less likely to be inundated by salt water, so other plant species are able to colonise the area. This results in a transition from one biome to another. In this case the transition is to salt marsh plants, which have their own ways of combating salt, then to *Casuarina* forest, and then to the climax vegetation, *Eucalypt* forest. These changes can occur in the space of a couple of hundred metres, which means they do not show on the small-scale maps of world biomes.

Geographical fact

Without mangroves many of the seafoods that we enjoy – prawns and many species of fish – would disappear from our shops and our tables.

An interesting factor to add here is the impact of rising sea levels. Examine Source 3.14 and 3.15.

The king tides only reach this area on a few days of the year. In Redcliffe (Queensland) these tides occur in January and February. Plants growing in this area, including the mangroves, have to adapt to this inundation. Source 3.16 shows the mangrove community at the maximum king tide level.

ACTIVITY 3.2

- 1 Suggest what the impact on this plant community would be if the sea level was always as high as shown in Source 3.15.
- 2 Discuss other possible future scenarios for this plant community.



Source 3.14 Incoming king tide covering the area inland of the Hays Inlet mangroves



Source 3.15 King tide at close to its maximum

Source 3.16 King tide on the Hays Inlet mangroves



ACTIVITY 3.3

- 1 Explain why the term 'rainforest' should be used more carefully.
- 2 Analyse why places far from the tropics consider their forests 'rainforests'.
- 3 Describe how mangroves have adapted to growing in salty water.
- 4 Compare the mangrove communities of South Australia and the mangrove communities of north Queensland.

Deserts

A desert is defined by having one of the following two climate features:

- 250mm of annual rainfall (or less)
- vegetation covering less than 50% of the ground.

The following research activity will show you how Australia's desert biomes have developed.

Geographical fact

Oceans make up 71% of the Earth's surface. This means 29% of the Earth's surface is land. Deserts make up 33% of the land's surface area. In other words, deserts make up one-third of the land's surface area.

RESEARCH 3.2

Choose one of the following topics:

- the animals that live in desert areas and how they manage to survive
- the plants that live in desert areas and how they manage to survive
- the way of life of the people who live in desert areas and how they manage to survive.

Use the internet and your school library to research one of these topics, then prepare a PowerPoint presentation for the class.

RESEARCH 3.3

Consider the role of people in changing biomes. It is easy to change an ecosystem. It can be catastrophic to change a biome. Many of Australia's biomes are similar to those in other parts of the world – deserts and savanna – but they are also very different. Discuss one of the research topics below and present your research in a short essay.

- Management of Australia's biomes has improved as people have started to learn from the way the Indigenous people managed the environment (focus on *Eucalypt* forests).
- The 'prickly pear' was introduced to Australia as a garden plant but soon became feral.
- Rabbits were introduced to Australia for sport and once released onto the wild soon became feral.
- Australian camels are considered a superior breed to their forebears from the deserts of the Middle East but are often regarded as feral animals in Australia.

Factors affecting Australian biomes

Chapter 2 identified climate as the main factor affecting the global distribution of biomes. Examining biomes at a larger scale allows for the closer examination of other factors which affect the distribution of biomes on a more local scale.

Mountain ranges

The pattern of biomes along Australia's east coast is influenced by the location of the Eastern Highlands, or the Great Dividing Range. This set of mountains, even though it is not high by world standards, has an orographic impact on the circulation of wind and the accompanying rainfall. Winds blowing in off the ocean are forced to rise, and they drop their moisture on the eastern side of the range. Source 3.2 and Source 3.3 show the effects of this. The figures show a narrow coastal vegetation pattern and a different vegetation pattern immediately to the west of the range.

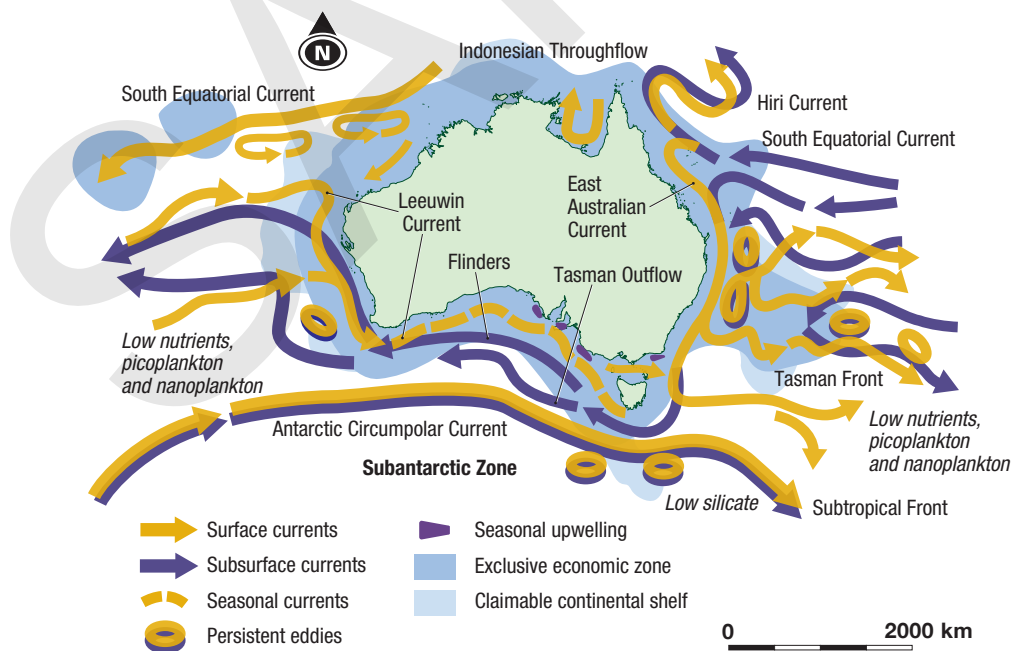
Ocean currents

The other impact on biomes which can be found by examining biomes at a larger scale is that of **ocean currents**. Source 3.17 is a detailed image of Australia's ocean currents.

Fans of *Finding Nemo* will immediately see the East Australian Current (EAC) which took Nemo's father, Marlin, south on his adventure.

What needs to be examined is where the currents are coming from, as this affects the temperature of the water and therefore the temperature of the air above them. The EAC is a warm current. It flows from north to south along the east coast of Australia. This warm current will warm the air above it, causing it to expand. As air expands, it can absorb more molecules of water, so the air moving across this current towards the Eastern Highlands holds lots of moisture. This is compressed when the air cools as it rises over the Eastern Highlands. The result is simple: lots of rainfall on the eastern side of the Eastern Highlands and much less on the western side.

ocean current the regular movement of water in the ocean in a particular direction



Source 3.17 Australia's oceanic currents

On the other side of the continent the situation is more complex. The western side of Australia does not have a clear annual oceanic flow. The South Equatorial Current (SEC) is blocked by currents flowing north from Antarctica. These waters are much colder, and they also have an impact on

the air flowing over them. Cold air does not pick up moisture from the ocean and so is unlikely to bring rain. As the air passes over the land it is warmed, and is therefore able to absorb moisture, making rain even less likely.

ACTIVITY 3.4

- 1 Using an atlas, locate the following:
 - a the Atacama Desert
 - b the Kalahari Desert
 - c the type of ocean currents that flow off-shore of these areas.
- 2 What is the relationship between the location of the desert and the type of ocean current flowing along the coast?

Seasonal air mass movements

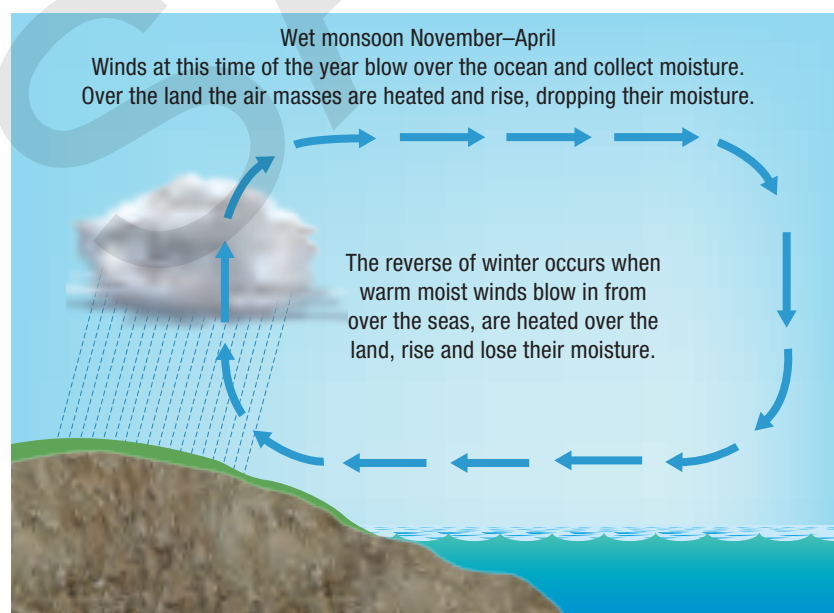
Monsoons

Northern Australia experiences a seasonal change in weather as Earth's changing location in relation to the Sun makes the Sun appear to move north and south of the equator. Air masses are affected by this: areas of low pressure move north as the Sun appears to move north (to the Tropic of Cancer) and south as it appears to move south (to

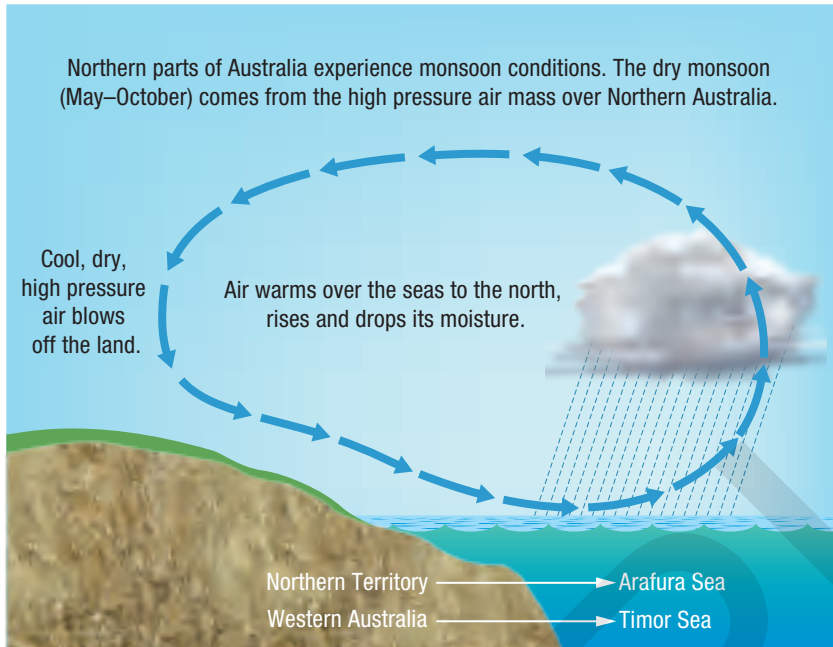
the Tropic of Capricorn). This affects the biomes in this part of Australia.

When the Sun appears to be over Australia's Tropic of Capricorn, it warms up the land there and causes the air above it to rise. This rising air draws in moisture from the surrounding sea bodies, and rainfall occurs. This promotes growth, especially of the grasses of the savanna areas of northern Australia.

When the Sun appears to be over the Tropic of Cancer, in the northern hemisphere, low



Source 3.18 Wet monsoon season



Source 3.19 The dry monsoon

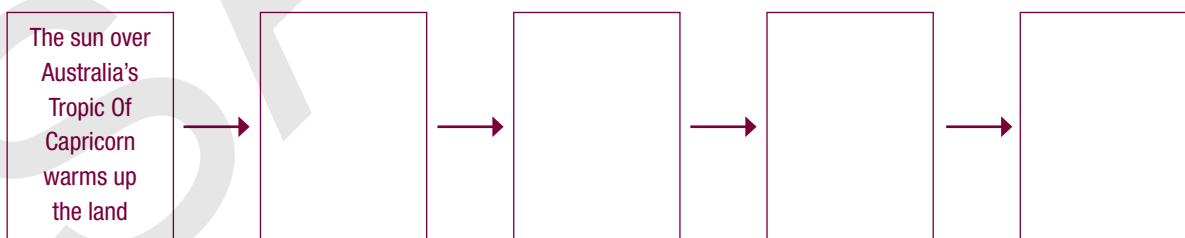
pressure air moves northwards and dry, stable, high pressure air takes its place over the Australian continent. This high pressure air comes from central Australia; it does not contain moisture and

is cold, and so it descends. The dry period begins, and continues until the Sun again appears to be over the Tropic of Capricorn. Source 3.18 shows how this seasonal change operates.

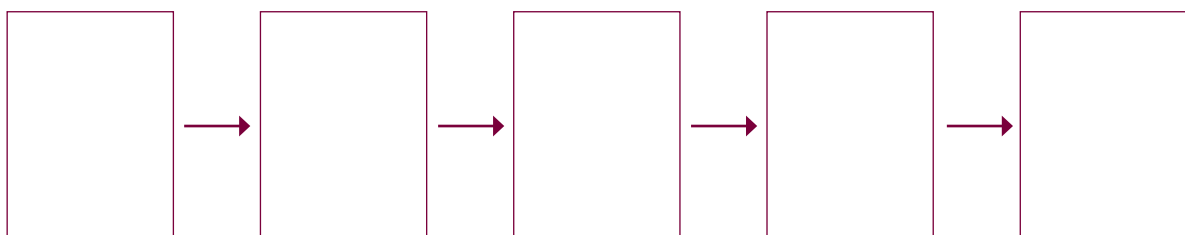
>>> **NOTE THIS DOWN**

Copy the graphic organiser below and outline how wet and dry monsoons form.

WET MONSOONS



DRY MONSOONS



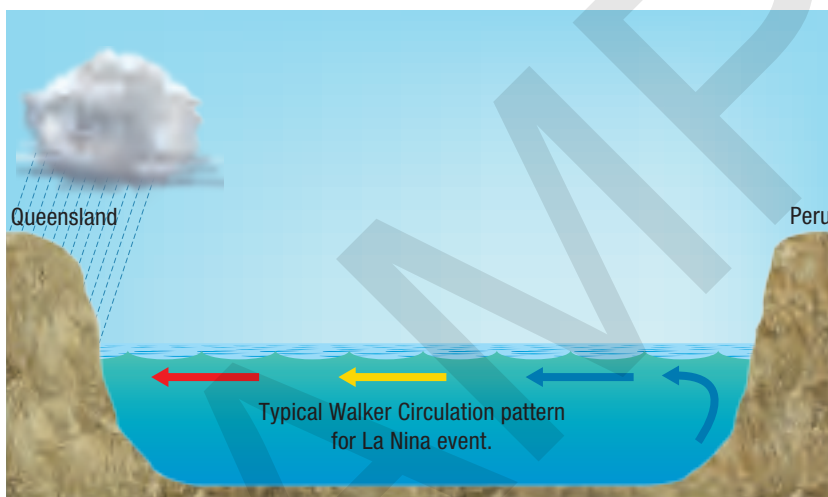
El Niño – La Niña

El Niño extensive warming of the eastern and central Pacific Ocean, leading to an increased possibility of dry conditions in eastern Australia

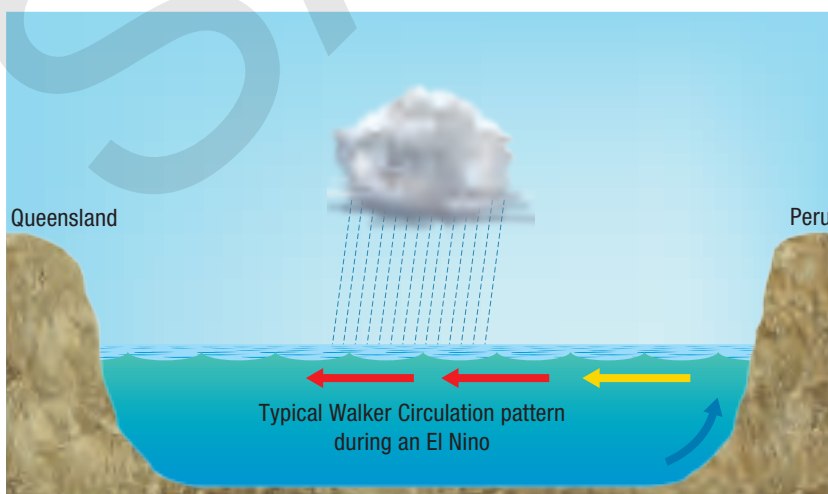
La Niña cooling of the central and eastern Pacific Ocean, leading to an increased possibility of wet conditions in eastern Australia

Weather patterns associated with **El Niño** and **La Niña** events may have more unpredictable impacts on biomes. The monsoons are an annual event but El Niño and La Niña weather events can last much longer. These events can bring flooding rain, or crippling drought, to northern and eastern Australia. They are predictable, which is of great help to Australian farmers: they can work out when to plant their wheat crop and when to expect rain to start the crop. However, the duration and intensity of these events are not so predictable.

They are driven by air mass movements generated by cold ocean currents flowing north along the coast of South America. If the flow of the current is strong, eastern Australia will experience a La Niña wet weather pattern; if the current is weak, eastern Australia will experience an El Niño dry weather pattern.



The Walker Circulation is named after Sir Gibson Walker, who described relationships between seasonal variations in climate patterns in the Asia-Pacific region.



Source 3.20 El Niño and La Niña weather patterns

ACTIVITY 3.5

- 1 Explain why vegetation cover, rather than the amount of rain that falls in a year, should be used as the method of identifying a desert area.
- 2 Analyse the similarities and differences between how plants and animals cope with desert conditions.
- 3 Explain how monsoons affect Australia's biomes.
- 4 Examine how El Niño and La Niña events affect Australia's vegetation patterns.

Case study 3.1

The loss of Australia's rainforests to sugar cane

Australia has for many years been one of the world's major suppliers of sugar. Australia is the third largest raw sugar supplier in the world: it produces \$2 billion worth of sugar each year. Sugar cane was brought to Australia with the First Fleet in 1788. Early plantings were in river valleys in New South Wales, but the industry began to flourish once areas along the Queensland coast were opened up. In Queensland the industry's development was helped by cheap labour brought to Australia from neighbouring Pacific Islands. However, many of these Pacific Islanders were brought to Australia against their will, and when the Commonwealth of Australia was proclaimed in 1901, laws were passed to stop the practice. Since that time the industry has undergone many changes.

Rainforests have been cleared for sugar cane: it needs to be grown in high-rainfall or irrigated areas along coastal plains and river valleys. The amount of

land used for sugar cane production has increased rapidly and this increase is predicted to continue. Sugar cane production occurs between the Great Barrier Reef and the wet tropics of Queensland. As more land is cleared for production there are risks that areas and habitats will be negatively affected.

Canegrowers is the industry group that represents the majority of cane growers, and supports sustainable sugar cane production to minimise impact on Australia's rainforests: tactics include leaving more plant residue undisturbed on the surface to reduce surface water runoff and soil erosion, and less frequent tillage, which also reduces the amount of energy farmers use to run tractors, reducing costs and saving resources. Even with these practices, though, some areas of Queensland are still in danger.

There are other practices used in the sugar cane industry that were once thought of as great advances, but that we now recognise as dangerous to parts of our environment. The article opposite, for instance, shows the damage that is being done by one particular pesticide.

Sugar cane production is very important to Australia's economy and agriculture, but it does affect the environment. Canegrowers and other groups strive to educate others about sustainable sugar cane production and minimise the industry's impact on the environment.

Pesticides and sugar cane

The Queensland and Federal Government's first report card on water quality in the Great Barrier Reef has found pesticides used in agriculture are causing significant problems for the reef.

The report says some farmers need to be more careful with their chemicals, finding that nearly one-quarter of horticulture producers and 12 per cent of graziers are using practices considered unacceptable by industry and the community.

In the case of the sugar cane industry, roughly one-third face the same criticism. Nick Heath from the World Wildlife Fund Australia says the sugar cane industry in the wet tropics had a 72 per cent rate of 'unacceptable practice'.

Mr Heath says the report shows government needs to further limit the use of chemicals, and he has called for a ban on the weedkiller Diuron.

'Pesticides have been found at toxic concentrations up to 60 kilometres inside the World Heritage area [of the Great Barrier Reef] and at concentrations known to harm coral,' he said.

'And you may be aware that there's a big die-off in turtle and dugong numbers at the moment as a result of the floods. Those floods are carrying these pollutants and they're basically destroying the sea-grass beds of Queensland.'

But the sugar cane industry's peak body, Canegrowers, says the data reflects practices of a few years ago, and says there has been significant change since then.

Source 3.21 Pesticides hurting Great Barrier Reef: report

ACTIVITY 3.6

- 1 Discuss why the rainforests were cleared to allow for the growth of sugar cane.
- 2 Explain why Queensland is such a suitable state for sugar cane production.
- 3 Describe why the production of sugar cane might affect Queensland's Great Barrier Reef.
- 4 Suggest why it is important for sugar cane producers to leave soil undisturbed as much as possible.

Source 3.22 Sugar cane fields in Australia



FIELDWORK 1.1 EXPLORING YOUR LOCAL BIOME

The purpose of this exercise is relate your local biome to the larger picture of biomes in Australia.

Aim

To analyse your local biome, link it to the wider Australian scene and examine the human impacts on this biome.

Method

Select an area of parkland, nature reserve or national park in your area.

Preparation

Find a map of the area and indicate the areas that will be visited and studied. You will also need to take a camera, a list of questions based on the 'data collection' section below, paper, a clipboard and a pen. Make sure you are appropriately dressed, with hat, full cover clothing and enclosed shoes, and that you have insect repellent.

Data collection

As you travel along the suggested path on this fieldwork trip, stop at various sites and collect the following information in preparation for your fieldwork report:

- 1 What is the major biome that this area is part of?
- 2 What characteristics of this biome can be found in this area? Take photos.
- 3 List all the ways in which the area is used. Take photos of these activities. Mark the location of these activities on your blank map. Provide a key to display your data collection. Are these activities active or passive? How often would the area be used for these activities? What is the major activity in the area?
- 4 To what extent does the location of the area being studied influence the type of activities in the area?
- 5 To what extent is the location of the area being studied influenced by the type of activities in the area?
- 6 Describe the positive and negative and short-term and long-term impacts of these activities on the area.

- 7 Sketch or photograph two examples of the ways in which the use of the area has affected the environment. Annotate your sketch with as much information as possible about the use and its impact.
- 8 Observe the human features surrounding the area. Describe how these are used.
- 9 List some of the management strategies you observe in the area. Determine whether the strategy is working or not and explain your reasoning. Suggest a new strategy for one of the impacts you identified in Item 7.

Field work presentation layout

Front page	Title and name
Contents page	Do this last, once you have numbered the pages
Page 1	Aims and methods
Page 2	Location map
Page 3	Introduction – Brief description of the study site
Page 4–5	Description of uses (and photos)
Page 6	Table of uses: Effects of use (positive or negative, short-term and/or long-term)
Page 7–8	Description of effects of use (and sketches and/or photos)
Page 9	Association between use and effects of use
Page 10	Table or written description of management strategies
Page 11	Photos or sketches of management strategies
Page 12	Evaluation of these strategies
Page 13	Appendix, bibliography, glossary

Chapter summary

- Because of its isolation from other continents Australia has developed a unique set of biomes.
- As the Australian continent has drifted northwards over millions of years, the flora and fauna which make up the biomes have adapted to changing environments.
- The pattern of biomes in Australia largely reflects the rainfall distribution map.
- Ocean currents along the western side of the continent affect biomes inland.
- The mountain ranges along the east coast affect the pattern of biomes along Australia's east coast.
- The largest biome in Australia is the desert biome: 18% of Australia's mainland is desert.
- There is only a small area of alpine biome in Australia because Australia does not have very high mountains.
- Mangrove communities are found in many sheltered waters and are very dense communities, often with a closed canopy.

End-of-chapter questions

Multiple choice

- Which is Australia's largest biome?
 - rainforest
 - alpine
 - desert
 - mangrove
- Which biome is found in the highest areas?
 - alpine
 - mangrove
 - desert
 - savanna
- Which biome is found in salty waters?
 - desert
 - savanna
 - mangrove
 - Mediterranean
- What would occur in the northern Australian biomes if the monsoon rains failed?
 - grasslands would die
 - trees would be stressed
 - wildlife would die
 - all of the above
- Which part of Australia is most impacted by La Niña weather patterns?
 - Tasmania
 - Victoria
 - South Australia
 - Queensland



Short answer

- 1 Which biome would you be in if you were walking around Uluru?
- 2 Which biome surrounds the desert biome?
- 3 Which biome is only found in New South Wales and Victoria?
- 4 Which biome extends from the tropical to the cool parts of Australia?
- 5 Name the mountains in Australia that have the main area of alpine vegetation.

Extended response

Desertification was identified by the United Nations as a cause of international concern in 2006. 'Desertification' is the term used to describe the expansion of desert areas into surrounding savanna regions. It has been linked to both changes in climate and changes in land use. Discuss the situation in relation to desert regions in Australia. Present your discussion in a short essay.





Source 3.23 An example of desertification caused by soil erosion resulting from overgrazing.)