# Geography

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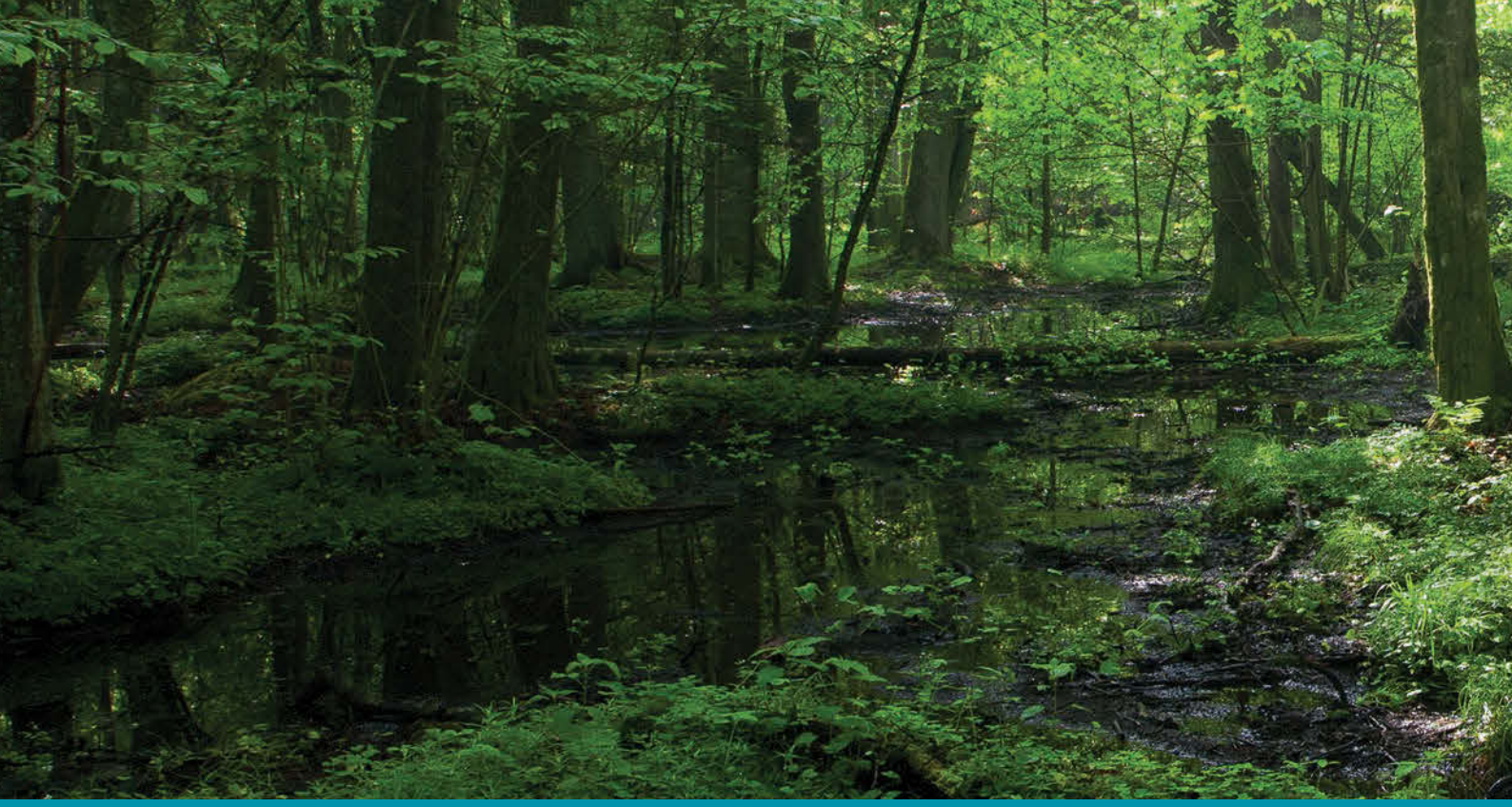
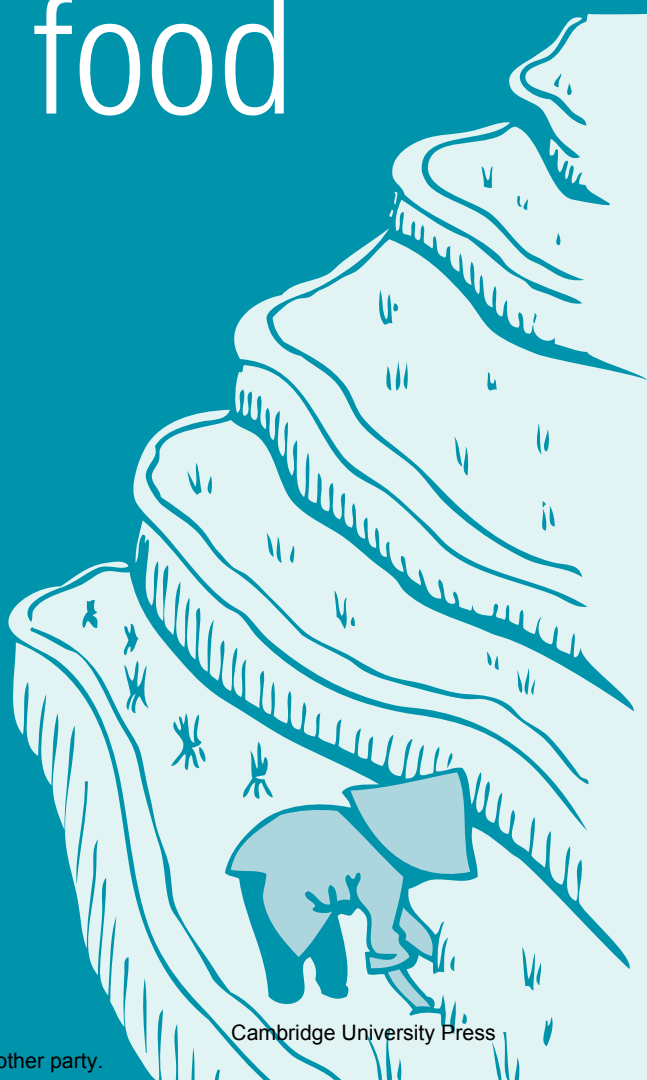


# Unit 1
# Biomes and food security



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# 1 Understanding ecosystems

## Before you start

### Main focus

One way of looking at the Earth's natural environment is to look at the different ecosystems that form the basis of life on Earth.

### Why it's relevant to us

Knowledge of the Earth's ecosystems is basic to understanding how the natural environment operates, how that environment can impact on people and the effects people may have on that environment.

### Inquiry questions

- What is an ecosystem?
- What are the main characteristics of an ecosystem?
- How have natural forces combined to allow for the development of these ecosystems?
- How and why are ecosystems important to humans?

### Key terms

- Climate
- Climax vegetation
- Decomposers
- Ecosystem
- Food chain
- Photosynthesis
- Primary producer
- Weather

## Let's begin

**climate** the long-term changes in temperature and rainfall experienced in an area

Geographers make sense of the world by dividing it into regions. The physical world around us – the plants, animals, soils, slopes and **climate** – can be divided into different-sized regions, depending on the scale of the study being undertaken. Even the study of a small part of the Earth's surface may divide that area up into different ecosystems.

An ecosystem is a natural region – a hill slope, a pond, a beach, a backyard. This natural region is based on a physical feature upon which a group of plants, animals and microorganisms have developed. Some geographers studying ecosystems take a large-scale approach to their studies. These geographers examine relationships between plants and animals, and natural and human features, in a small area. Geographers who take what is known as a small-scale approach examine regions covering a much larger area. These regions are known as biomes and are the subject of the next chapter.

It is sometimes difficult to map ecosystems and biomes because they are subject to change – which may be long term, such as in the changes caused by the uplifting of mountains, or rapid, as in change following a cyclone, flood or bushfire.

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# 1.1 Ecosystems

**ecosystem** an area of the Earth's surface where living organisms interact with parts of the Earth

An **ecosystem** is an area where non-living (abiotic) parts of the Earth's surface and biotic (living) organisms interact. They interact in such a way that a small area may be identified as a region.

Geographers may be interested in studying this ecosystem from a variety of viewpoints. They may be interested in what causes the ecosystem to function as a unit or in how the ecosystem is changing over time and what might be causing that change. They may also be interested in what changes might occur in the ecosystem if certain changes were made to it.

The key part of the word is 'system'. The various parts work together just as the parts of your body do or the parts of a car do. Ecosystems require 'inputs' to make them function – just as your body needs food and a car needs fuel of some sort.

Ecosystems also have 'outputs' – waste material resulting from the processes required to keep the ecosystem functioning. Your body may sweat. It certainly emits various wastes as gases, liquids and solids. A car converts the fuel into the energy required to move it forward and emits various gases as a result of the energy transformation process.

The ecosystem, the body and the car all require inputs from the world around us. This world can be divided into two parts – the abiotic and the biotic.

### Geographical thought

The hair on your head is an interesting ecosystem: thousands of microscopic creatures live in and on your hair. These creatures actually wage war on each other. For them, the entire universe is your head.

## Abiotic components of an ecosystem

The abiotic part of an ecosystem is that part of the ecosystem which is non-living. There are many abiotic components of an ecosystem. All of these are essential parts of the ecosystem and contribute to the type of ecosystem that develops. Those components are as follows:

- sunlight
- temperature
- wind
- rainfall
- rocks
- soil
- gas.

## Biotic components of an ecosystem

The biotic parts of an ecosystem are its living parts. These are closely related to the abiotic components of the ecosystem. The biotic parts of an ecosystem include the following:

- *Flora* is the plant life found in a region at a particular time.
- *Fauna* is the animal life found in a region at a particular time.
- *Fungi* look like plants but are in fact organisms (such as smuts, moulds, mushrooms and mildews).

## How do ecosystems work?

Ecosystems are dynamic. The parts operate together just as the parts of a human body or a car work together. Ecosystems are subject to change.

These changes may occur daily, annually or over a longer period of time.

Ecosystems on Earth are driven by the power of the sun. Radiation from the sun provides the heat that is essential for life on Earth. Without the sun, Earth would be a frozen rock whirling through space. Approximately 30% of this radiation is reflected back into space by clouds, aerosols, ice and snow. The remaining radiation is absorbed by the land, the oceans, the atmosphere and human structures.

The sun provides the Earth with light and heat. If you are a light sleeper, you will notice the arrival of the sun as the sky brightens and birds begin their daily activity. If your house has solar panels, you will notice that the output from the panels increases as the day progresses. The reverse occurs as the sun begins to set.

Source 1.1 shows the simple relationships within an ecosystem.

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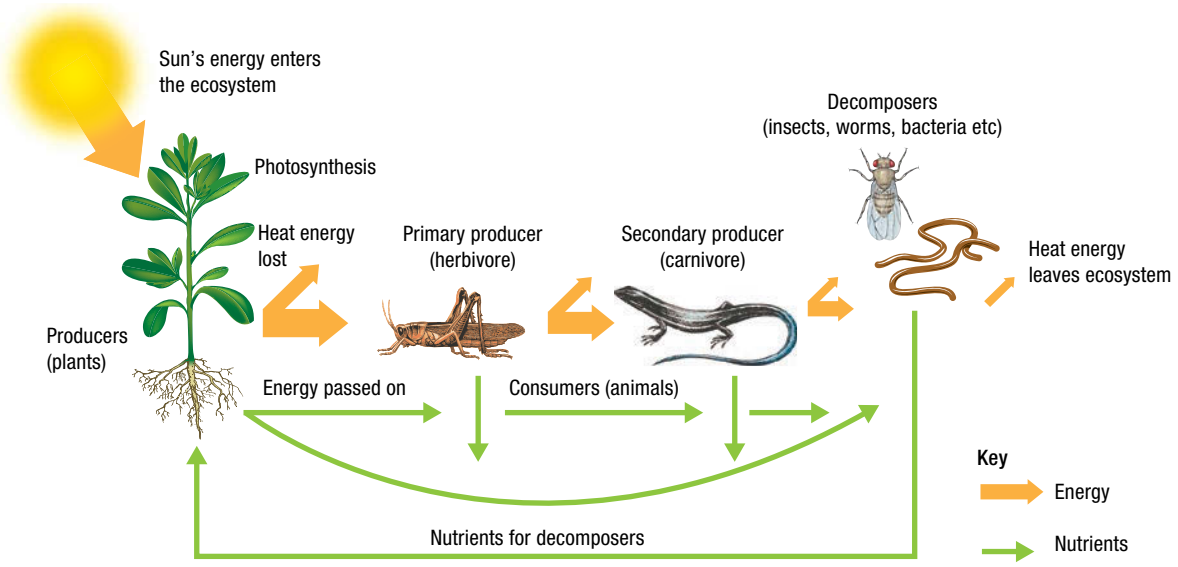
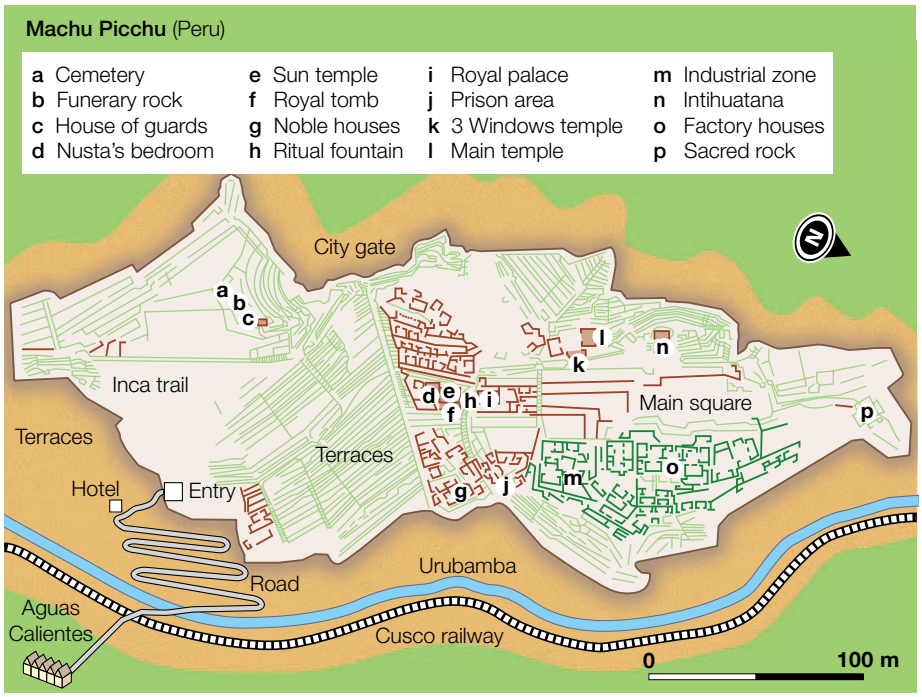



**Source 1.1** Simple ecosystem diagram

Machu Picchu, in Peru, is a favourite destination for international travellers. Machu Picchu was constructed by the Incas around the middle of the fifteenth century, but was abandoned by them when the Spanish invaded Peru.

Machu Picchu has a layout that excites modern geographers and town planners, with clear areas set aside as a main square, an area for the upper classes or nobles, an industrial area and an area for workers' housing. Surrounding the city centre, and separated




**Source 1.2** Machu Picchu town plan

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**solstice** the two times of the year when the sun is at its greatest distance from the celestial equator. The summer solstice is the longest day of the year and the winter solstice is the shortest

from it by a wall, was an agricultural area. Perhaps the most significant feature of the town was its orientation in relation to the sun.

The sun temple is designed so that the rays of the sun on the winter **solstice** shine into it.

Some distance away is the Sun Gate. This is the point through which the sun's rays first light up Machu Picchu each day.

**Source 1.3** Machu Picchu, high in the Andes Mountains, was carefully oriented in relation to the sun.

## 1.2 The sun and the abiotic environment: weather

**weather** the state of the atmosphere at a given time

The sun has a major impact on the abiotic environment. Let's start by examining the impact of the sun on **weather**. Weather refers to the day-to-day changes in the Earth's atmosphere in terms of:

- **precipitation**
- temperature
- humidity
- wind speed and direction
- air pressure.

**precipitation** water, in forms such as rain, snow, sleet or hail, that condenses in the air, becomes too dense to remain suspended, and falls to the Earth's surface

## 1.3 The sun and the abiotic environment: rocks and soil

**in situ** in the original position; not having been moved

Temperature changes associated with the heat of the sun are a major cause of mechanical or physical weathering, which is the breakdown of rocks **in situ** as a result of different components of rocks heating up and expanding at different rates, or water in cracks and crevices in the rocks freezing during the cooler hours of the night and the rock being broken apart by the expanding ice.

## 1.4 The sun and the biotic environment: flora and fauna

**photosynthesis** the process of plants converting sunlight to energy

**chlorophyll** the green substance in plants that allows them to use the energy from the sun

Sunlight generates the process of **photosynthesis** in plants. This process is essential for much of life on Earth. Photosynthesis is a complex chemical process, involving **chlorophyll**, carbon dioxide, water and sunlight, and produces the carbon and sugar compounds necessary for plant growth and the release of oxygen so necessary for animal life (including human life) on the planet.

Plants have a number of roles in ecosystems.

Some plants provide shade in which other plants will grow. Some plants are hosts for other plants; climbers and epiphytes, for example, need host plants. Many plants have special adaptations that allow them to grow in specific areas (mangroves and cacti, for example).

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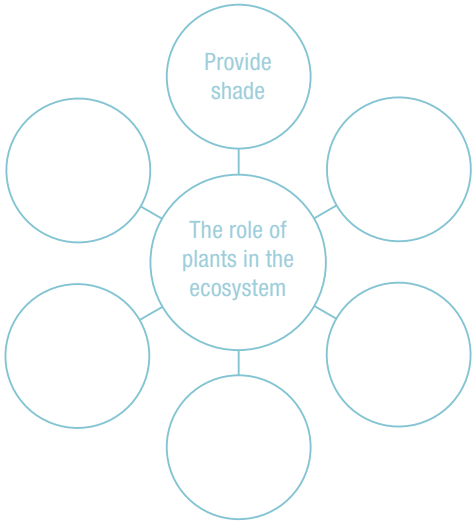
**Source 1.4** Black sand beach in Hawaii formed by the erosion of basalt

All plants die, and in death they decompose and provide food for other plants.

Around the world there are some very difficult areas for plants to colonise. The growth of plants in these areas requires colonising plants with very special adaptations. These plants stabilise the environment and allow other plants, plants that are not adapted to the initial conditions, to eventually move into an area.

## DEVELOPING YOUR UNDERSTANDING 1.1

Copy the graphic organiser below and explore the different uses of plants.




The first plants to inhabit an area are known as the **colonisers**.

**coloniser** the first to inhabit an area

The role of the colonisers is to establish an environment which will allow other plants to grow. The colonisers help break down the rock into soil, and when they die they provide plant nutrients for a later group of plants. Eventually the environment is changed significantly by different groups of plants. A soil layer is developed and larger plants then provide protection for seedlings of still larger plants. The most dominant form of vegetation in an area is known as the **climax vegetation**. Climax vegetation is the major plant community that will develop in an area given the existing climatic conditions.

**climax vegetation** the most dominant form of vegetation in an area

For a large part of eastern Australia, the climax vegetation is eucalypt forest. Don't lose sight of the fact that it is the sun that is driving this vegetation development.

The animal kingdom is affected by sunlight in two ways. The time of day can have a significant effect on when animals are active. Some are **diurnal**. These animals are active during the day: giraffes and wildebeest, for example, are diurnal. Some are **nocturnal**. These are active at night: owls and flying foxes, for example, are nocturnal. Some are **crepuscular**. These are active in the twilight hours of early morning and early evening: many birds, for instance, use these hours to visit water sources. Deer, too, are most active in the twilight hours.

**diurnal** active during the day

**nocturnal** active at night

**crepuscular** active at dawn or in the early evening

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The other way sunlight affects the animal kingdom is through its effect on vegetation.

There are animals which only eat plant material. These are the **primary producers** in an ecosystem. Primary producers can be as small as caterpillars and as large as giraffes. They convert plant material into the food needed for their survival.

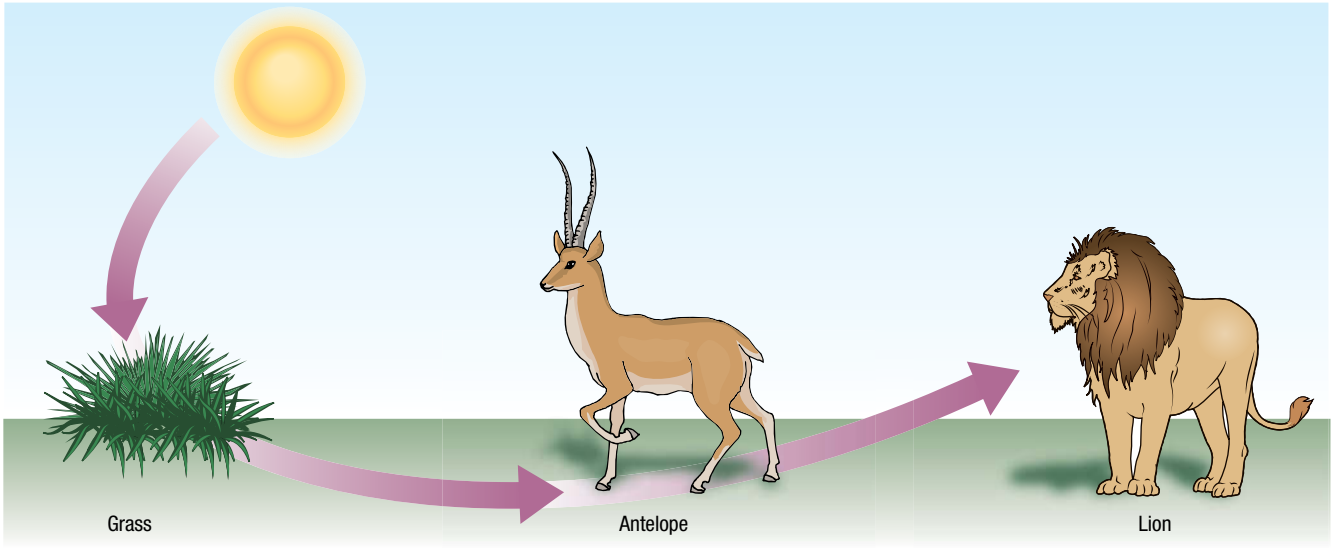
**primary producer** an animal that eats only plant matter

They also produce waste products, in the form of gases, solids and liquids, which assist in the breakdown of plant material. On a more important level, many primary producer animals are the food of the next level of animals in the **food chain** – the carnivores.

**food chain** the sequence of feeding arrangements in an ecosystem in which each member may be food for the next highest member of the chain

These animals eat other animals.

Source 1.5 is a simple version of what happens in many parts of the world. The sun provides the necessities for plant growth. A herbivore grazes on the plants and a carnivore consumes the herbivore.




Source 1.5 Simple food chain in a small ecosystem

The actual situation is not that simple. The study of biomes in the next chapter will investigate the relationships between plants, animals and the environment in more detail.

The interesting thing about human beings is that they have an increased ability to survive because they consume all levels of the food chain, from the plants at the base (such as carrots, tomatoes and peas) to the herbivores (cows, antelopes, kangaroos) to the carnivores (sharks, crocodiles).

The role of the sun's energy in relation to plant and animal life on Earth is not over even when plants and animals die. Many of the wastes remaining when a plant or animal dies go through further processing to return their nutrients to the environment. This is where the **decomposers** come in. They break down the decaying life form into nutrients which can be used again in the ecosystem.

**decomposer** an animal, fungus or bacterium that breaks down or cleans up waste matter

Scavengers form part of this group. Crows, Tasmanian devils and hyenas are scavengers. (Hyenas also hunt.) Fungi and bacteria are other life forms that assist in the decomposition of plant and animal remains.

## DEVELOPING YOUR UNDERSTANDING 1.2

1 Describe the role of the colonisers.
2 Predict the impact on the ecosystem if the decomposers were eliminated.
3 Create your own food chain based on your own diet.

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# 1.5 Introducing another variable: humans

For some considerable time humans have had a major impact on ecosystems on the Earth's surface and that impact is increasing. The impact can be small, such as using insecticide on an ants' nest (though that is certainly not a small event for the ant colony), or so large as to completely destroy ecosystems. Using an insecticide on an ants' nest is a deliberate attempt to destroy an ecosystem, but other actions may work to save an ecosystem.

Humans have not always had the degree of control over ecosystems that they have today.

Humans were originally very much an integral part of the ecosystem: they lived in caves, gathered roots and berries and hunted wild animals during the day. Humans themselves were hunted by those wild animals.

Fire became an important tool for humans. It provided warmth and protection. Australia's first inhabitants used fire to modify the environment for their own use. Fire was used to remove undergrowth and encourage the growth of new shoots, which would attract animals. It has only recently been recognised that there was often a pattern to the burning. This pattern left a mosaic of sections of undergrowth at different stages of development. Some of this undergrowth provided protection for the animals the people hunted. The important thing was that catastrophic bushfires were prevented, as different parts of the land were in different stages of recovery from deliberate fires.

In time, humans learned which plants could be grown in certain areas and which animals could be brought under control.

**domestication** the process of taming animals or cultivating plants for uses that benefit humans

This knowledge resulted in the **domestication** of plants and animals and is the basis of agriculture in the modern world.

Over time humans have become established at the top of the ecosystem. Humans can save, protect, destroy or modify an ecosystem. The sequence should probably be:

Modify → Save → Protect

In reality, the sequence in many places has probably been:

Destroy … → and where do we go from here?

## The Tasmanian tiger

The thylacine, better known as the Tasmanian tiger, was native to Australia and primarily found in Tasmania and some regions of Victoria. It was the country's largest carnivorous marsupial and had existed for over 4 million years.

The introduction of humans and dogs to the environment brought disease and predators to the ecosystem of the thylacine, and numbers declined drastically. Thylacines were kept in zoos, but suffered in captivity. They were also hunted by farmers who assumed the thylacine had been killing their sheep.

The last thylacine died in captivity in 1936, and although sightings have been reported and extensive searches carried out, there is no conclusive evidence of the creature being still in existence.

Currently, scientists are making attempts to clone thylacines from preserved specimens.

## DEVELOPING YOUR UNDERSTANDING 1.3

1. What were the possible impacts of the extinction of the thylacine in Tasmania?
2. Discuss how ecosystems in Tasmania would be affected if the thylacine was cloned and returned to its natural ecosystem.
3. Describe the steps taken by modern conservationists to help prevent more species becoming extinct.
4. Research and list plants and animals that have been rediscovered since they were declared extinct.

Humans have been altering ecosystems for thousands of years. Increasing populations required more food than could be provided by hunting and gathering. Providing more food required clearing land of its vegetation cover. In many parts of the world the flow of water had to be altered to provide water for larger and larger areas of crops and for the increasing number of livestock being raised. The flow of water also

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had to be altered to provide for increasing numbers of people living in settlements. The Industrial Revolution placed even more pressure on ecosystems as trees were cut and burned, and later coal and oil were extracted from the ground. Cities were built and spread across the countryside and communication networks of road and rail were constructed to connect them.

In the desire for this kind of progress, ecosystems for a long time took second place in humans' thinking. In parts of the world where development is still seen as the primary goal, or in places where disputes cannot be settled without conflict, ecosystems still take second place.

Fortunately, in other places the need to save and protect ecosystems is regarded as important.

As a result, an international network of botanical gardens and zoos seek to protect and enhance the future of plant and animal species that are under threat. There is also a network of reserves, state forests and, more importantly, national parks – both on land and on the water – which seek to preserve ecosystems. There are no guarantees that the efforts will be successful, but the efforts must be made.

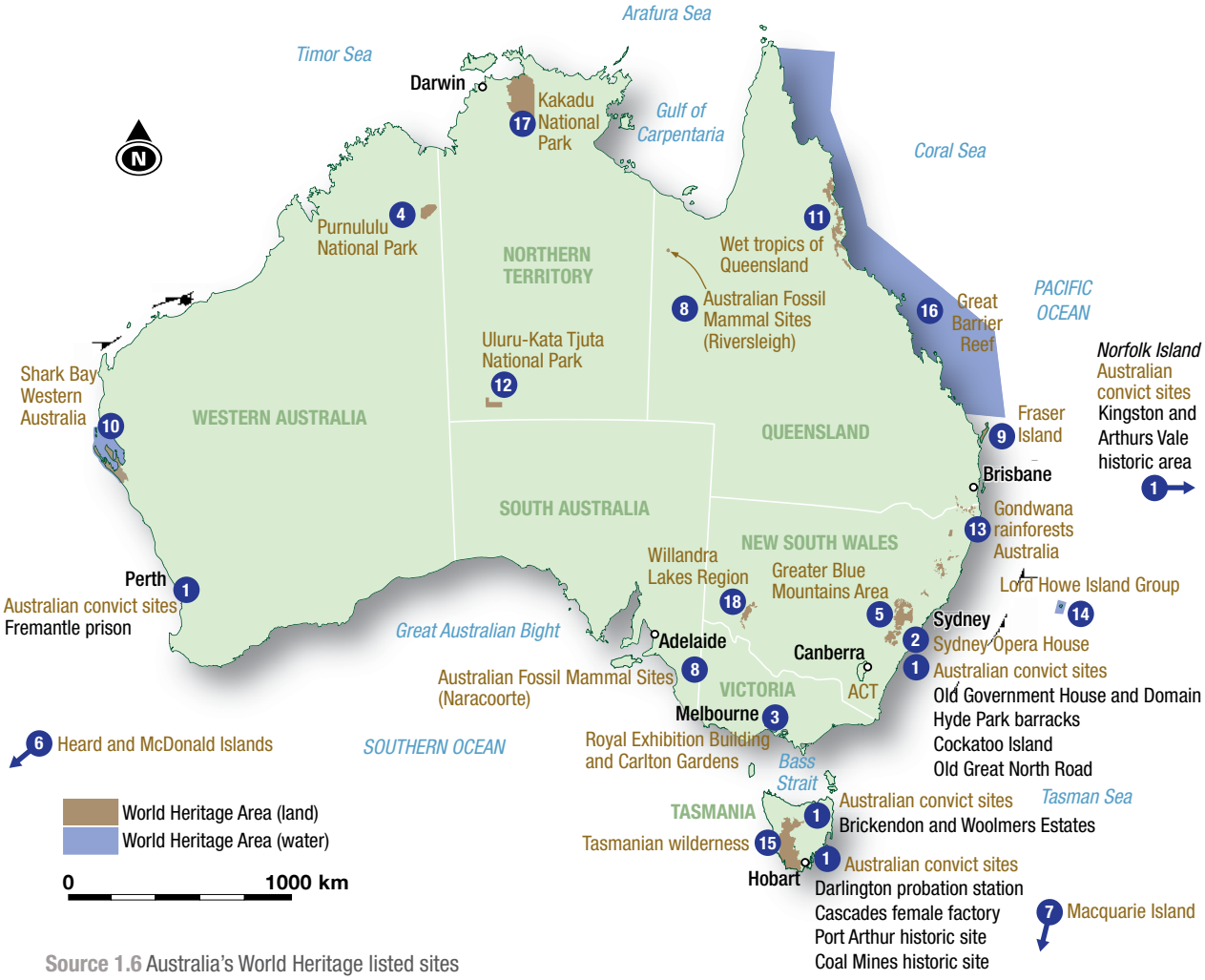
The world's first national park – Yellowstone, in the United States – was opened on 1 March 1872.

Australia's first national park was the National Park, south of Sydney. It was opened on 26 April 1879. It was the world's second national park. It was renamed the Royal National Park after a visit by Queen Elizabeth II in 1955.

In 1972, the United Nations recognised that parts of the world needed to be set aside as having special cultural or physical significance. By 2012, 962 sites had been recognised by the UN Educational, Scientific, and Cultural Organization (UNESCO) as World Heritage listed sites.

While world governments realise that parts of the Earth's surface need to be protected, it is not always easy, or possible, to do so. The fight to save the Cooloola area of Queensland was a classic example of the will of the people clashing with the government of the day and a mining company.

Many clashes like this have occurred in the past 50 years, and many are under way around the world today.




**Source 1.6** Australia's World Heritage listed sites

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## Geographical thought

It is interesting that the majority of sites identified are of cultural significance – the pyramids and the Mayan temples, for example. Only 188 sites are considered to be of significance because of their physical environmental characteristics. At the end of 2012, Australia had 19 sites listed and two sites awaiting approval.

## DEVELOPING YOUR UNDERSTANDING 1.4

1. List the impacts that humans have had on the environment.
2. Suggest other types of creatures that have had a negative impact on an ecosystem.
3. Describe how humans can have a positive impact on the environment.
4. Evaluate the methods used to determine whether or not to preserve an area or site. Are some sites more significant than others? Explain why.

**Source 1.7** The World Heritage listed Great Barrier Reef

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# Reflecting and consolidating

## Chapter summary

- Ecosystems have both living and non-living components. All these parts work together, with 'inputs' to make them function and 'outputs' – waste material resulting from the processes – required to keep the ecosystem functioning.
- Ecosystems are dynamic, responding and adapting to changes made by humans, the weather and animals (for example).
- Ecosystems exist at all types of scales, wherever abiotic parts of the Earth's surface and biotic organisms interact.
- Ecosystems are important for the continued existence of life on Earth. Humans can have significant and damaging impacts on ecosystems by introducing waste and pollution, and even destroying ecosystems.
- The need to save and protect ecosystems is regarded as important in some areas of the world.

## Short-answer questions

1 Describe how the sun affects an ecosystem on a daily basis.

2 Describe how the sun affects an ecosystem on an annual basis.

3 Define 'food chain'.

4 Explain the relationships between the non-living and the living parts of an ecosystem.

5 Discuss how humans can have an impact on an ecosystem.

## Extended-response question

Pildappa Rock is near Minnipa in South Australia. It is one of a number of 'wave rocks' in Australia.

Examine the pictures below. Your task is to tell the story of the ecosystems here without using any other information source. What information is provided by the four images? What evidence of the information presented in this chapter is shown in them? Present your findings in a short report.

Source 1.8 Pildappa rock showing its wave rock shape

Source 1.9 Summit of Pildappa Rock showing the uneven nature of this granite formation

Source 1.10 An ecosystem on the summit of Pildappa Rock

Source 1.11 The hollow in this rock is also an ecosystem.

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