

Biodiversity of Deserts

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Contents

| | |
|--|----|
| What is biodiversity? | 4 |
| Why is biodiversity important? | 6 |
| Deserts of the world | 8 |
| Desert biodiversity | 10 |
| Desert ecosystems | 12 |
| Threats to deserts | 14 |
| <i>Biodiversity threat: Grazing animals and invasive species</i> | 16 |
| <i>Biodiversity threat: Wildlife trade and hunting</i> | 18 |
| <i>Biodiversity threat: Mining, farming and building roads</i> | 20 |
| <i>Biodiversity threat: Climate change</i> | 22 |
| Desert conservation | 24 |
| Case study: The Sonoran Desert | 26 |
| What is the future for deserts? | 30 |
| <i>Glossary</i> | 31 |
| <i>Index</i> | 32 |

CASE STUDY:



To read the second part of the case study, click on the page number to go to the next page.

Glossary words

When a word is printed in **bold**, click on it to find its meaning.

What is biodiversity?

Biodiversity, or biological diversity, describes the variety of living things in a particular place, in a particular **ecosystem** or across the whole Earth.

Measuring biodiversity

The biodiversity of a particular area is measured on three levels:

- **species** diversity, which is the number and variety of species in the area
- genetic diversity, which is the variety of **genes** each species has. Genes determine the characteristics of different living things. A variety of genes within a species enables it to **adapt** to changes in its environment.
- ecosystem diversity, which is the variety of **habitats** in the area. A diverse ecosystem has many habitats within it.

Species diversity

Species diversity changes from one habitat to another. Habitats such as rainforests and deserts have different levels of biodiversity. Within a desert habitat, hyraxes live in rocky **outcrops**. Horned vipers and marsupial moles live in sand. Other animals live in desert grasses.

Habitats and ecosystems

Deserts are habitats, which are places where animals and plants live. Within a desert habitat, there are also many different types of smaller habitats, sometimes called microhabitats. Some desert microhabitats are sand dunes, stony plains, waterholes, hummock grasses and rocky outcrops. Different kinds of **organisms** live in these places. The animals, plants, other living things and non-living things and all the ways they affect each other make up a desert ecosystem.

The biodiversity of Sahara Desert habitats, in Africa, is low.

Biodiversity under threat

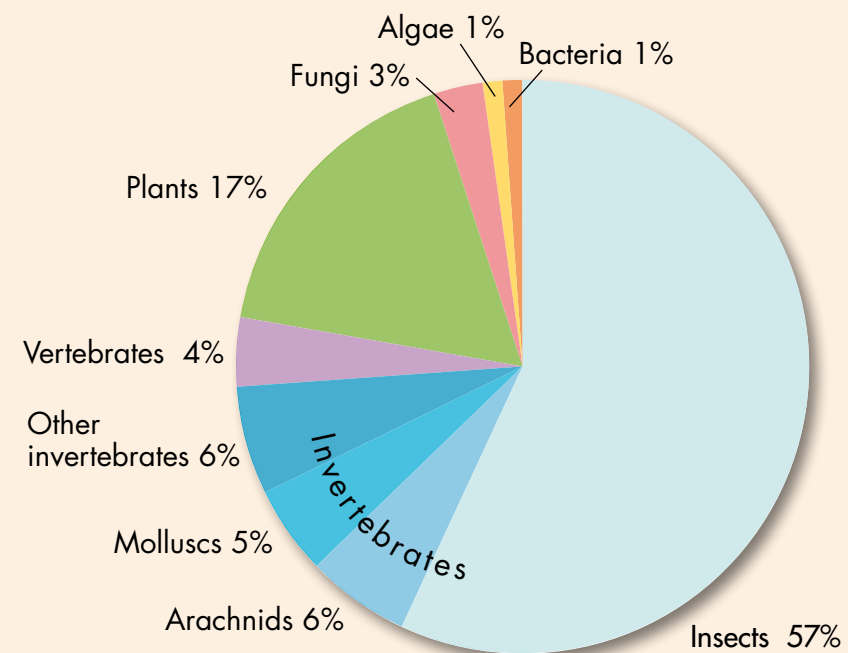
The variety of species on Earth is under threat. There are somewhere between 5 million and 30 million species on Earth. Most of these species are very small and hard to find, so only about 1.75 million of these species have been described and named. These are called known species.

Scientists estimate that as many as 50 species become **extinct** every day. Extinction is a natural process, but human activities have sped up the rate of extinction by up to 1000 times.

Did you know?

About 95 per cent of all known animal species are invertebrates, which are animals without backbones, such as insect, worm, spider and mollusc species. Vertebrates, which are animals with backbones, make up the remaining 5 per cent.

Known species of organisms on Earth



The known species of organisms on Earth can be divided into bacteria, algae, fungi, plant and animal species. Animal species are classified as vertebrates or invertebrates.

Approximate numbers of known vertebrate species

| ANIMAL GROUP | KNOWN SPECIES |
|--------------|---------------|
| Fish | 31 000 |
| Birds | 10 000 |
| Reptiles | 8 800 |
| Amphibians | 6 500 |
| Mammals | 5 500 |

Why is biodiversity important?

Biodiversity is important for many reasons. The diverse **organisms** in an **ecosystem** take part in natural processes essential to the survival of all living things. Biodiversity produces food and medicine. It is also important to people's quality of life.

Natural processes

Human survival depends on the natural processes that go on in ecosystems. Through natural processes, air and water is cleaned, waste is decomposed, **nutrients** are recycled and disease is kept under control. Natural processes depend on the organisms that live in the soil, on the plants that produce oxygen and absorb **carbon dioxide**, and on the organisms that break down dead plants and animals. When **species** of organisms become **extinct**, natural processes may stop working.

Food

We depend on biodiversity for our food. The world's major food plants are grains, vegetables and fruits. These plants have all been bred from plants in the wild. Wild plants are important sources of **genes** for breeding new disease-resistant crops. If these wild plants were to become extinct, their genes would be lost.

Medicine

About 40 per cent of all prescription drugs come from chemicals that have been extracted from plants. Scientists discover new, useful plant chemicals every year. The United States Cancer Institute discovered that 70 per cent of plants found to have anti-cancer properties were rainforest plants.

When plant species become extinct, the chemicals within them are lost forever. The lost chemicals might have been important in the making of new medicines.

Did you know?

Biodiversity varies over time. Fossils show us that many species of animals and plants found in deserts in the past have become extinct.

Quality of life

Biodiversity is important to people's quality of life. Animals and plants inspire wonder. They are part of our **heritage**. Some species have become particularly important to us. If the blue whale became extinct, our survival would not be affected, but we would feel great sadness and regret.



Animal species such as blue whales inspire people's wonder and imagination. This improves our quality of life.

Extinct species

The desert rat-kangaroo is a rabbit-sized mammal that lived in stony desert country in inland Australia. It did not shelter from the heat in a burrow. Instead, it built a flimsy grass nest. Little was ever discovered about the desert rat-kangaroo because its **habitat** was so remote. Cats and foxes introduced to Australia probably preyed on the small mammal. The last time the desert rat-kangaroo was seen was in 1935. The extinction of this and other species is reducing the Earth's biodiversity.

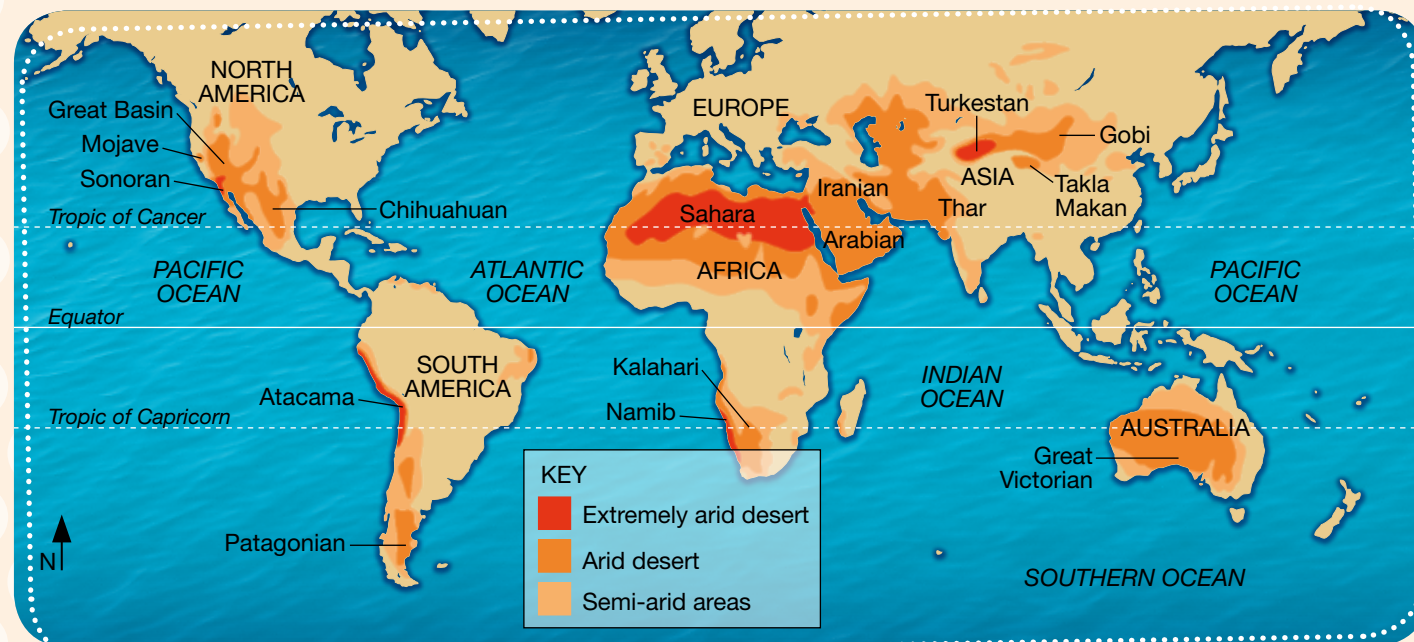
Deserts of the world

A desert is an area that normally has less than 250 millimetres of **precipitation** each year. Only some plant and animal **species** can live in these dry conditions. Deserts are found on all continents of the Earth, except Europe.

Types of desert

There are many types of desert **habitats** across the world. Some deserts are called hot deserts. These deserts are found in **tropical** areas. Cold deserts are found at high elevation or in **temperate** or polar regions.

Deserts have different physical features. Some deserts have sand dunes, and others have stony ground. Some deserts have cliffs and mountains, and others have vast salt flats.



The world's major deserts are located in North America, South America, Africa, Asia and Australia. Europe has some semi-arid areas but no real deserts.

Antarctica

Antarctica is a desert continent. Annual precipitation on the coast is about 200 millimetres. Inland, precipitation is less than 50 millimetres. There are no trees or shrubs in Antarctica. No vertebrate animals live entirely on land in Antarctica. All have to go to sea to feed, or they migrate to other places in winter.

Major deserts of the world

| NAME AND LOCATION | TYPE OF DESERT | PHYSICAL FEATURES | | | | AREA (square kilometres) |
|---|----------------|-------------------|---------------------------|------------|-----------|--------------------------|
| | | Sand dunes | Sandy and/or stony plains | Salt flats | Mountains | |
| Sahara Desert, in northern Africa | Hot | X | X | X | X | 9 100 000 |
| Arabian Desert, on the Arabian Peninsula | Hot | X | | | | 2 300 000 |
| Gobi Desert, in northern China and southern Mongolia | Cold | | X | | | 1 200 000 |
| Patagonian Desert, in Argentina | Cold | | X | | | 600 000 |
| Turkestan Desert, in central Asia and south-western Russia | Cold | X | | | | 559 000 |
| Chihuahuan Desert, in northern Mexico and south-western USA | Hot | | | | X | 455 000 |
| Great Basin, in western USA | Cold | | X | X | X | 411 000 |
| Great Victorian Desert, in Australia | Hot | X | X | | | 349 000 |
| Takla Makan, in western China | Cold | X | | | | 270 000 |
| Sonoran Desert, in south-western USA and northern Mexico | Hot | | X | | | 223 000 |
| Thar Desert, in India and Pakistan | Hot | X | | | | 200 000 |
| Atacama Desert, on the coast of Chile | Cold | | X | | | 180 000 |
| Namib Desert, on the coast of south-western Africa | Hot | X | | | | 135 000 |
| Mojave Desert, in south-western USA | Hot | | X | X | | 65 000 |

Desert biodiversity

Deserts are very dry places. Low **precipitation** limits plant growth and only a relatively small number of plant **species** can survive in desert conditions. In turn, this limits the number of animal species that can live in a desert.



A dingo searches for food in the harsh environment of Australia's Sturt Stony Desert.

Desert animals and plants

The animals and plants that live in a desert have features that enable them to survive the harsh conditions. They are **adapted** to their environment.

Because of their adaptations, desert animals and plants are often quite unlike animals and plants of other **habitats**. The leaves of many desert plants have waxy surfaces to prevent water loss.

Deserts have a large number of **endemic species**. The protection of deserts is essential to the survival of these species.

Did you know?

*For thousands of years, Indigenous Australians burned different patches of desert each year, so that there was a patchwork of **vegetation** at various stages of regrowth. Each patch attracted different kinds of animals for hunting. These fires enriched the desert's biodiversity.*

Varied habitats and varied biodiversity

There are different types of deserts and each desert has many types of habitats within it. Desert habitats include sand dunes, stony plains and cliffs. Deserts may have moist creek beds, scattered waterholes and salt flats. In some deserts, there are even oases, where water is plentiful. Different species of animals and plants have evolved to survive in these different habitats.

Plants and animals of the Atacama Desert

The Atacama Desert, in Chile, is the driest desert on Earth. In some parts of its 180 000-square-kilometre area, rain has not fallen for hundreds of years, and the soil is so dry that even **bacteria** cannot live in it. Though very few animal species are found in the Atacama Desert, the biodiversity of the desert is very important. Many of its endemic species are remarkable for being able to survive in some of the world's harshest conditions. Some shrub species survive by collecting moisture from sea fogs that drift in from the Pacific Ocean.



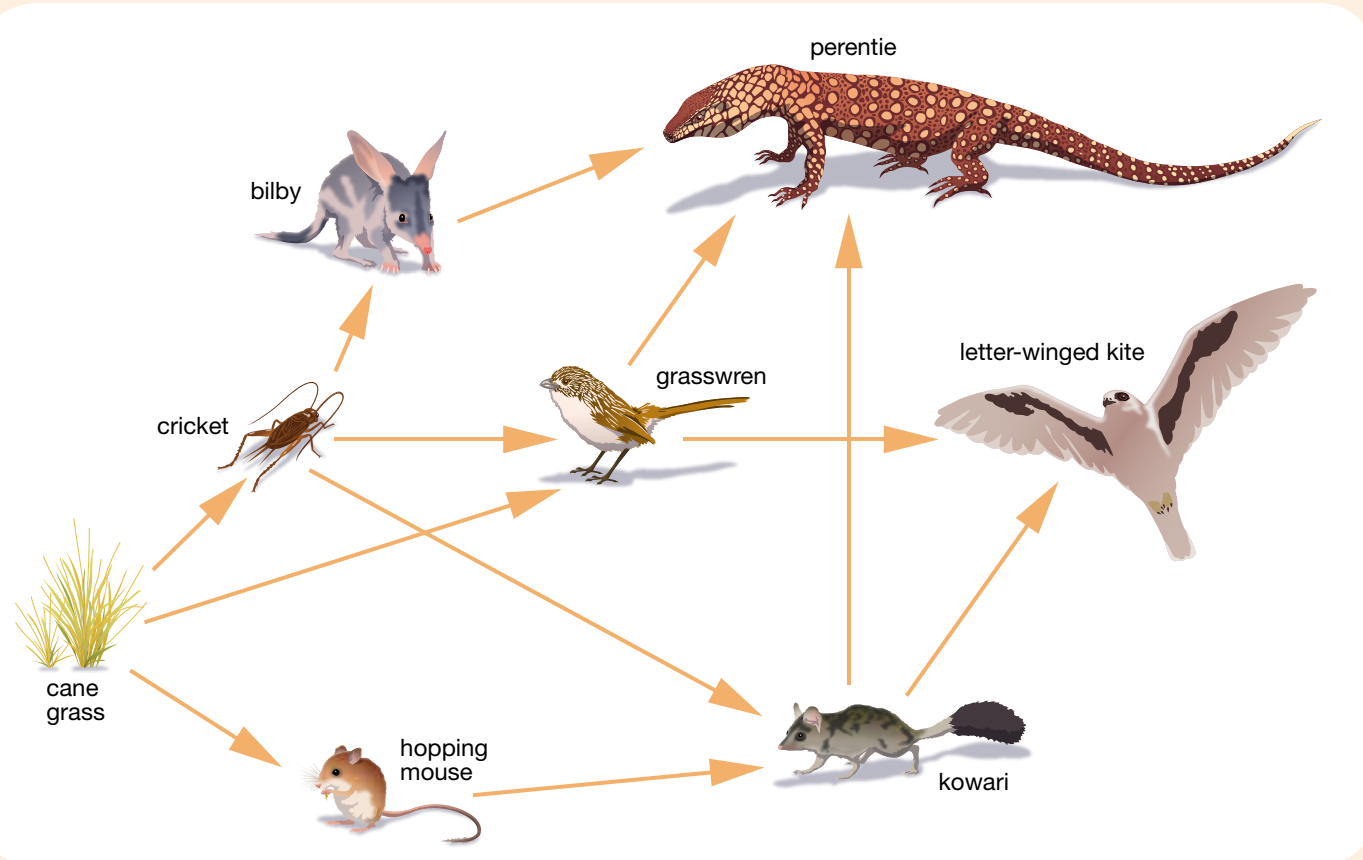
The plants of the Atacama Desert have evolved to survive in its very dry conditions.

Desert ecosystems

Living and non-living things, and the **interactions** between them, make up desert **ecosystems**. Living things are plants and animals. Non-living things include the rocks, sand, soil, water, wind, sunshine and frost.

Food chains and food webs

A very important way that different **species** interact is by eating or consuming other species. This transfers energy and **nutrients** from one **organism** to another. A food chain illustrates this flow of energy, by showing what eats what. Food chains are best set out in a diagram. A food web shows how many different food chains fit together.



This Australian desert food web is made up of several food chains. In one food chain, cane grass is eaten by grasswrens, which in turn are eaten by perenties.

Other interactions

Non-living things and living things in a desert interact in other ways, too. Where the soil is soft, desert animals such as hopping mice dig burrows to escape the heat of the day. Snakes often use the burrows of small desert mammals to shelter from the midday heat. Larger animals, such as dama gazelles, find shade beneath acacia trees or among rocks.

Desert rainfall

Rainfall is scarce in a desert but every ten years or so there may be a heavy fall of rain, called a deluge. Seeds that have lain dormant, or inactive, in the soil sprout and the desert is soon carpeted in wildflowers.

Animals, too, respond to the heavy rain. Frogs that have buried themselves deep in the soil emerge to breed, and fish swim out from their desert pools to find new pools. Animals take advantage of the plant growth. In Australia's Simpson Desert, budgerigars and squatter pigeons arrive to feast on seeds.

Couch's spadefoot toad

Couch's spadefoot toad of the Sonoran Desert, in Mexico and the United States, survives the dry desert **climate** by spending up to ten months of the year one metre underground. It digs its own burrow or uses the burrows of kangaroo rats. When it rains, the spadefoot comes to the surface, mates and lays eggs. These hatch in nine hours and the tadpoles become adults in about ten days.

After a deluge of rain, deserts bloom with wildflowers.

BIODIVERSITY THREAT:

Threats to deserts

Deserts are often thought of as wastelands. This attitude has meant that deserts and their biodiversity have not been given as much protection as they need. Today, the biodiversity of many deserts faces a range of threats.

Biodiversity hotspots

A biodiversity hotspot is an area that has a high number of **endemic species** and biodiversity that is still mainly intact, but this biodiversity is under threat. Threats to biodiversity hotspots come from such things as agricultural and **urban** development, the wildlife trade and pollution.

Throughout the world, there are only two biodiversity hotspots that are entirely desert. These hotspots are the Horn of Africa in north-eastern Africa and the Succulent Karoo of south-western Africa.

Species of the Succulent Karoo and the Horn of Africa

| SPECIES GROUP | SUCCULENT KAROO | | HORN OF AFRICA | |
|-----------------|-------------------------|---------------------------|-------------------------|---------------------------|
| | Total number of species | Number of endemic species | Total number of species | Number of endemic species |
| Plants | 6 356 | 2 439 | 5 000 | 2 750 |
| Mammals | 75 | 2 | 220 | 20 |
| Birds | 226 | 1 | 697 | 24 |
| Reptiles | 94 | 15 | 285 | 93 |
| Amphibians | 21 | 1 | 30 | 6 |
| Freshwater fish | 28 | 0 | 100 | 10 |

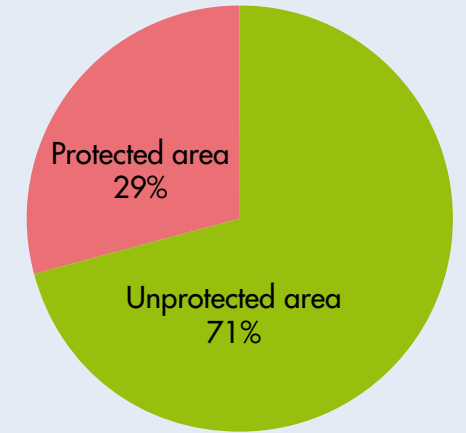
Halfmens

The halfmens is a very strange **succulent** plant of the Succulent Karoo. It is called the halfmens because from a distance it looks like a person walking up a hill. The plant grows to about 4 metres high and has a stem that resembles an elephant's trunk, so it is also called elephant's trunk.

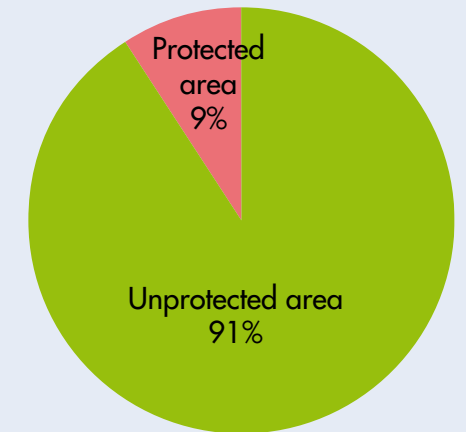
Human threats to biodiversity hotspots

Only 300 000 people live in the Succulent Karoo hotspot. This is just 3 people per square kilometre, so human population pressure is not a serious threat to the region's biodiversity. Major threats to the hotspot are mining, overgrazing, plant-stealing and farming.

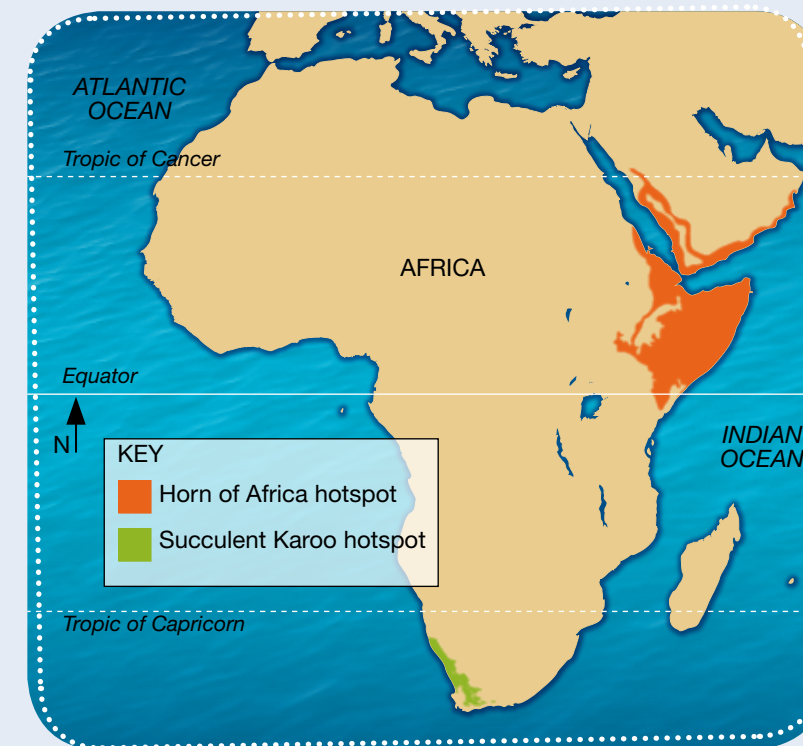
In the Horn of Africa, however, the population density is around 23 people per square kilometre. This many people places great pressure on the region's biodiversity. Only 5 per cent of the region's original **vegetation** remains due to firewood collection and overgrazing by domestic animals. Major threats to the hotspot are overgrazing, war, hunting and wood collection for making charcoal.



The Succulent Karoo hotspot covers a total area of 102 000 square kilometres.



The Horn of Africa hotspot covers a total area of 1 666 000 square kilometres.



Both the Succulent Karoo and the Horn of Africa hotspots are in Africa.

BIODIVERSITY THREAT:

Grazing animals and invasive species

Animals such as cattle, sheep and goats wander over large areas of desert and graze on the best pickings. These and other **invasive species** alter the desert **ecosystem** and threaten biodiversity.

Grazing

Farm animals are often allowed to graze over large areas of desert. Over time, this changes the biodiversity of these areas. Grasses are eaten out by sheep and cattle. Goats browse the leaves and strip the bark off shrubs, which may not survive. The desert animals that live in or on those grasses or shrubs lose their **habitat**. Cattle, goats and sheep have hard hooves, which break up the desert soil as they walk across it. The soil blows away, taking with it valuable **nutrients** needed by desert plants. Heavy cattle also trample the burrows of desert animals.

Invasive plants

Invasive plants are plants that are brought to an area and which then thrive in their new home and become environmental weeds. These **species** may take over from local species, and some local species may disappear altogether from certain areas. Tamarisk, also called salt cedar, is a northern African tree that was introduced into Australia and the United States. It spread rapidly along desert watercourses, taking over native **vegetation**.

Tamarisk trees have spread through desert habitats in Utah, in the United States.



Invasive animals in Australia's deserts

In the last 200 years, about half of the world's mammal extinctions have occurred in Australia. Most of these were small-sized to medium-sized desert mammals. The main causes of these extinctions are the European red fox and the **feral** cat. These introduced and invasive species prey heavily on small to medium mammals.

The European rabbit is another introduced species. It grazes heavily on desert plants. Where rabbits have been controlled, many plant species have reappeared, growing from seed in the desert soil. Feral horses and donkeys roam desert regions of Australia, too. They graze on desert plants and their hard hooves turn desert soil to dust.



The mala of the Tanami Desert, in Australia, is hunted by invasive animals such as cats and foxes.

Did you know?

Up to 1 million camels roam wild across Australia's deserts. These animals descended from camels brought to Australia by explorers in the 1800s. A herd of camels can drink a desert waterhole dry, leaving no water for native wildlife.

BIODIVERSITY THREAT:

Wildlife trade and hunting

Desert plants and animals are taken illegally by **poachers** and sold in the wildlife trade. Other desert animal **species** are hunted by people for food.

Pet trade

The Egyptian tortoise is among the world's most endangered tortoises, mainly because of the illegal pet trade. It is no longer found in Egypt and only just survives in Israel and Libya. Males grow to just 12 centimetres and females grow to 9 centimetres. Many people want Egyptian tortoises as pets. When they buy one from a pet shop, however, they do not know that the tortoise they have bought may have been caught illegally in the wild.



The Egyptian tortoise is one of the world's smallest tortoises and is popular as a pet.

Nursery trade

Desert plants are popular additions to many gardens. Many desert plants sold in plant nurseries have been taken illegally from the wild. In Mexico and the United States, many species of cacti are dug up in the Chihuahuan Desert for sale in city nurseries. In Africa, **succulent** plants of many kinds are removed from deserts in the Horn of Africa and the Succulent Karoo and sold as far away as Europe.

Did you know?

Stealing plants is a major threat to biodiversity and the effects are long lasting. The saguaro cactus takes 100 years to grow just 2 metres tall, so it takes a very long time to be replaced.

Hunting

Scimitar-horned oryx, Arabian oryx and addax are desert antelopes. Desert people have hunted these animals for their meat and skins for thousands of years. The animals' impressive horns are highly prized, too. When cars and rifles became available to desert people, many more of these animals were killed. In 1972, the Arabian oryx became **extinct** in the wild. The scimitar-horned oryx is also thought to be extinct in the wild. Addax survive only in isolated areas of the Sahara Desert.

In 1982, Arabian oryx were reintroduced into the wild, in Oman, from a herd bred from captive animals. These animals had been extinct in the wild for ten years, due to hunting.



The effects of war

War in Somalia and other parts of the Horn of Africa has had serious consequences for desert biodiversity. Many animals, especially large plant-eating animals, are hunted for meat. Ibex, oryx, gazelles and zebras are among the animals most affected. War disrupts where animals can roam, and government responsibilities such as wildlife protection are neglected.

BIODIVERSITY THREAT:

Mining, farming and building roads

Mining, agricultural activities and road-building change the **habitat** of many desert **species**. Mining destroys desert habitats, farming takes water from deserts and roads disrupt and disturb wildlife.

Mining

A lot of mining takes place in deserts around the world. Mining involves disturbing the ground to remove the minerals beneath it. As a result, **vegetation** is destroyed. Almost all of the Succulent Karoo coastline, in Africa, has been mined for diamonds. There is also mining for marble, titanium and other minerals.

Mines affect biodiversity and so too do other activities associated with mining. Mining employees' four-wheel drives are a major threat to the gravel plains of the Namib Desert, in southern Africa. These vehicles damage lichen and other slow-growing desert plants, which take years to recover.



A desert in South Africa is mined for diamonds.

Farming

Crops grown in desert regions require **irrigation**. Irrigation takes water from other areas and it reduces the amount of water available for the desert habitat, sometimes by huge amounts. In the Chihuahuan and Sonoran desert regions of the United States and Mexico, water is scarce. Up to 90 per cent of the water of the Rio Grande, which flows through the Chihuahuan Desert, is diverted for irrigation. In 2001, this river dried up altogether.

Damming desert rivers

In the Succulent Karoo of south-western Africa, grapes, citrus fruits, tobacco and vegetable crops are grown on farms. These crops are irrigated using water collected from dams that have been constructed on rivers of the region. Damming the rivers changes the water cycle and the desert **ecosystem**. More dams are proposed in the Succulent Karoo.

Roads

Roads break up a desert, cutting off one area of habitat from another. This is called habitat fragmentation.

A road built through a desert affects desert wildlife in several ways. It:

- is a physical barrier to animal movement
- is a danger to the animals that do cross it
- separates populations of the same species, increasing inbreeding, and so limits genetic diversity in a species
- allows vehicles bringing **invasive species** to enter the desert
- allows **poachers** and hunters into the desert.

Roads passing through deserts bring invasive species, poachers, cars and trucks, all of which endanger local species.

Disappearing wilderness areas

A desert wilderness area is a remote area of desert, more than 5 kilometres from any road or building, where there are no signs of human activity. Desert wilderness areas are essential to the continuing **evolution** of desert biodiversity, free of human disturbance. Scientists predict that with roads, towns and grazing pressures, wilderness areas may decline from 59 per cent of total desert area in 2005 to between 31 and 44 per cent by 2050.



BIODIVERSITY THREAT:

Climate change

The world's average temperature is rising, in a process known as global warming. Global warming results in **climate** changes, such as reduced rainfall in deserts and an increasing number of desert fires. This climate change has consequences for desert biodiversity.

Global warming

Levels of certain gases, such as **carbon dioxide**, are increasing in the Earth's atmosphere. These gases, called greenhouse gases, trap heat in the atmosphere, as glass does in a greenhouse. The overall increase in temperature, called global warming, is causing changes to the Earth's climate. These changes are affecting deserts.

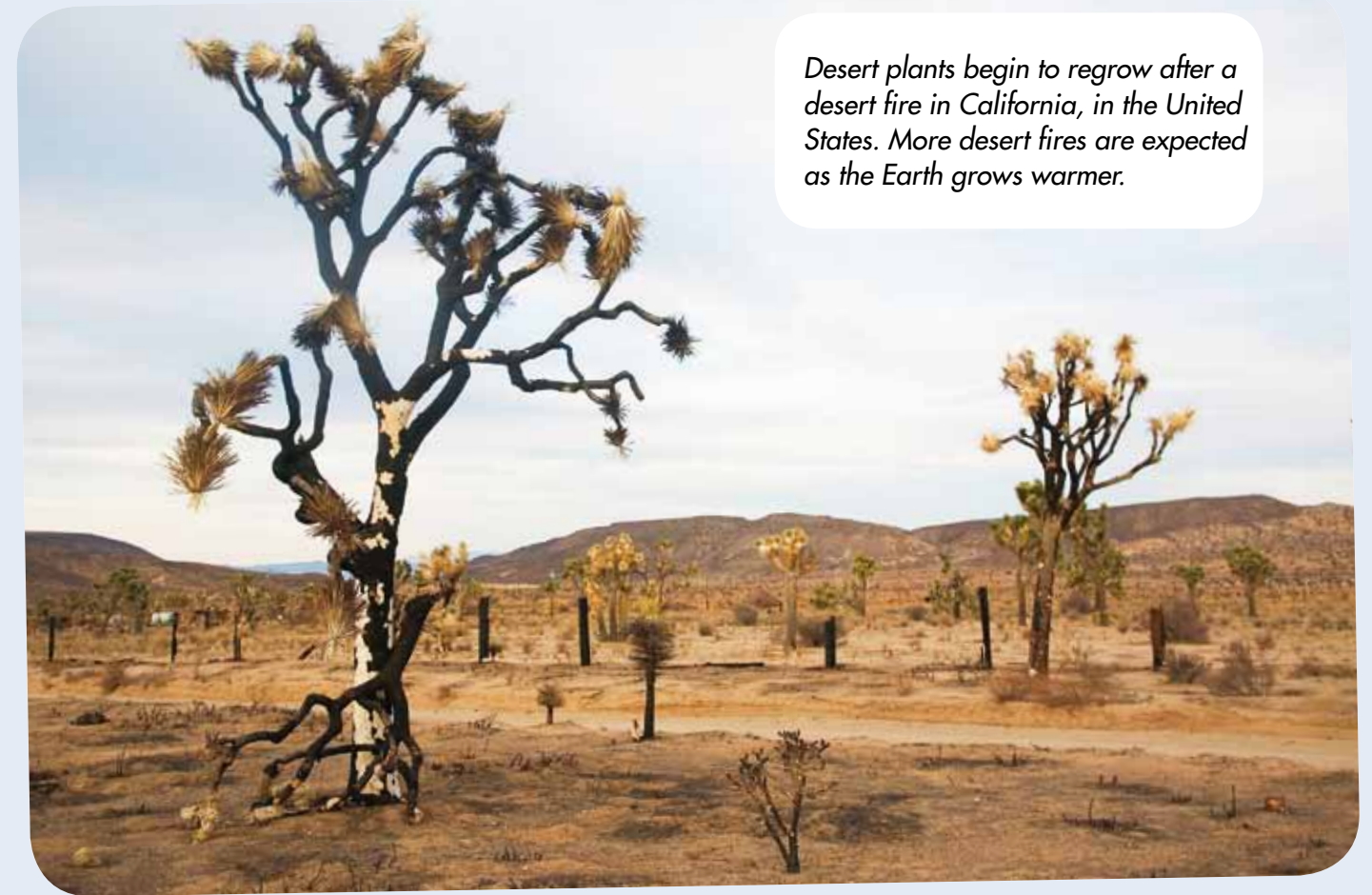
Reduced rainfall

Desert plants and animals live in a **habitat** where rainfall is already very scarce. If desert rainfall declines any further, due to climate change, many **species** may not be able to survive. If rainfall in the grassland and woodland habitats surrounding deserts declines, new desert habitat will form. Desert species may be able to move into these areas.

Desert fish migration

In many deserts, fish are confined to waterholes for years at a time. Every ten years or so, heavy rains bring floods. The fish breed and spread out across the flooded land. If climate change means that the waterholes dry up or that periodic flooding occurs less often or does not occur at all, many desert fish species face **extinction**.

Rain is rare in the desert, and climate change may make it even rarer.



Desert plants begin to regrow after a desert fire in California, in the United States. More desert fires are expected as the Earth grows warmer.

More fires

Rising temperatures are likely to increase the number and intensity of desert fires. Fires kill trees and shrubs, but grasses regrow soon after being burned. In time, an increase in the number of fires would change desert biodiversity. Trees and shrubs would be replaced by grasses. Animals that feed on or shelter in trees or shrubs would lose their habitat. Those species that live among the grasses or eat grass seeds may increase in number.

Did you know?

In a study conducted between 1975 and 2000, scientists found the average temperature increased in nine out of twelve studied deserts. From these findings, scientists predict average temperature in all deserts will increase by between 1 and 7 degrees Celsius by 2100.

Desert conservation

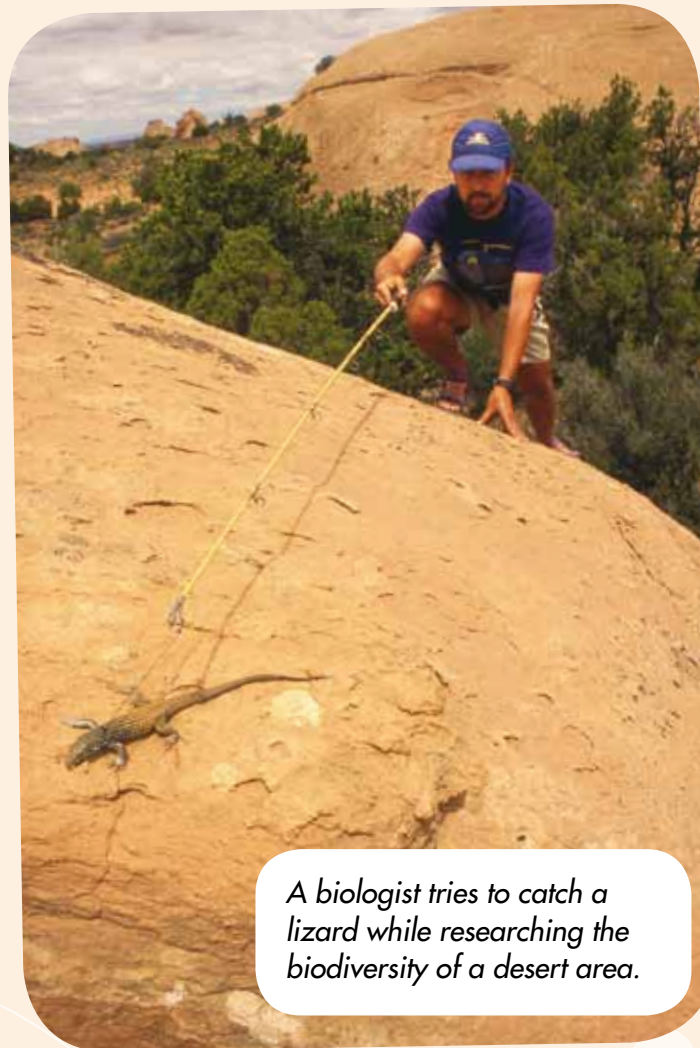
Conservation is the protection, preservation and wise use of resources and **habitats**, such as deserts. Some human activities threaten desert biodiversity and cause conservation problems. Research, education and the establishment of desert reserves can help conserve desert biodiversity.

Conservation problems

Human threats are changing desert biodiversity. Scientists have predicted that in the Chihuahuan Desert, half of the bird, mammal and butterfly **species** will be replaced by other species by 2055. Conservation will help prevent this loss of biodiversity.

Research

Research surveys or studies are used to find out information about deserts, such as how desert **ecosystems** work and how humans affect them. Research helps people work out ways to conserve desert biodiversity. Studies are carried out by scientists, many of whom work for governments and conservation organisations. Naturalists, who are people who study nature as volunteers, also help collect information and data.



A biologist tries to catch a lizard while researching the biodiversity of a desert area.

Desert soils store carbon

Research has shown that **bacteria** in desert soil take **carbon dioxide** from the air and convert it to **humus**. This enriches the soil for plant growth and reduces the amount of carbon dioxide in the atmosphere.

Desert tortoise decision

In 2001, a Californian court ruled that cattle grazing was no longer allowed on 2000 square kilometres of the Mojave Desert, in California, the United States. This decision was made to protect the endangered desert tortoise. Cattle trample this animal and its burrows and eat the plants it feeds on.

Desert reserves

Setting aside areas of deserts as national parks and other reserves is important. These areas need to be managed so that **invasive species** do not spread and so that illegal activities, such as wildlife poaching, are prevented. Only a very small proportion of the world's deserts is protected in reserves.

A group of children are taught how to conserve desert plants in the Chihuahua Desert, in Mexico.



Education

Educating people about desert conservation is very important. People who live in desert areas are often taught how to grow gardens that do not need much water. They are also taught not to use plants that may become environmental weeds in the desert. Schools and organisations such as the Arizona–Sonora Desert Museum in Tucson, Arizona, in the United States, educate people about living harmoniously with the desert environment.

CASE STUDY:

The Sonoran Desert



The Sonoran Desert of south-western United States and northern Mexico covers about 220 000 square kilometres. It has many **habitat** types and **climates**. Many organisations are working to protect its biodiversity from threats.

Biodiversity of the desert

The Sonoran Desert has many habitats, such as sand dunes, rocky plateaus and mountains. The climate varies across the desert. Some parts have annual rainfall of up to 300 millimetres a year. In the driest parts of the desert, there is just 90 millimetres of annual rainfall. With such a diverse range of habitats and climate, the Sonoran Desert has among the richest biodiversity of any desert.

Species of the Sonoran Desert

| SPECIES GROUP | NUMBER OF SPECIES | EXAMPLE OF SPECIES |
|---------------|-------------------|---|
| Plants | 560 species | Includes the creosote bush and saguaro cactus, which is the world's largest cactus |
| Birds | 261 species | Includes the roadrunner, several hummingbird species and 2 endemic species |
| Mammals | 60 species | Includes the pronghorn antelope, desert bighorn sheep, puma and ring-tailed cat |
| Reptiles | 58 species | Includes 6 rattlesnake species and the gila monster, which is one of the world's two venomous lizards |
| Fish | About 30 species | Includes the longfin dace and speckled dace |
| Amphibians | About 12 species | Includes the tiger salamander, which is the world's largest land-based salamander |

Nutrient-rich areas

Legumes are plants that take nitrogen gas from the air and make nitrates, which are **nutrients** that enrich the soil and help plant growth. In places where legumes such as ironwood and palo verde grow in the Sonoran Desert, a great variety of other plant **species** also grows.

Threats to biodiversity

Sonoran Desert biodiversity is threatened by many human activities. The cities of Phoenix and Tucson, in Arizona, are growing. **Urbanisation** results in housing developments replacing the habitats of desert animals such as bighorn sheep and pronghorn antelope. Other threats include:

- farming and agriculture, which has spread along the rivers that flow through the region. Farms take water from the desert rivers, reducing the amount available for desert habitats.
- off-road driving by city people on the weekends, which does serious damage to desert **vegetation**
- trophy hunting, which is hunting large animals for sport. In Mexico, bighorn sheep are shot by hunters who pay large sums to landowners.

Buffel grass

Buffel grass was introduced into the Sonoran Desert region from Africa. It was established as grass for grazing cattle. Buffel grass forms dense patches that burn easily and result in fires so hot that ironwood and other native plants are killed. The buffel grass survives the fire. Over time, the desert scrub becomes dominated by buffel grass, threatening biodiversity.

The Sonoran Desert spreads across California and Arizona, in the United States, and Baja California and Sonora, in Mexico.



CASE STUDY: The Sonoran Desert



Protecting the Sonoran Desert

Protection of the remaining areas of the Sonoran Desert is very important. Farming, grazing and **urbanisation** have already altered about 60 per cent of the United States' area of the desert.

National parks

Only about 17 per cent of the United States' part of the Sonoran Desert is protected in national parks. Four new parks have been established on the Mexican side of the desert. Altogether, these reserves form the largest area of protected desert in North America.

The national park areas, however, do not connect to other protected areas. This means that wildlife may become isolated in certain areas, unable to migrate across the whole desert. Already, highways are a major barrier to the movement of some **species**, such as toads and lizards.

Coalition for Sonoran Desert Protection

The Coalition for Sonoran Desert Protection is a community organisation of 30 000 people in Tucson, in Arizona. The group is committed to 'the conservation of biological diversity and ecological function of the Sonoran Desert'. The coalition and government created the Sonoran Desert Conservation Plan, which sets out how desert **habitats** will be protected from inappropriate development.

Research and education

Research and education are vital to the conservation of the Sonoran Desert. Several organisations are involved in educating schools, the public and tourists.

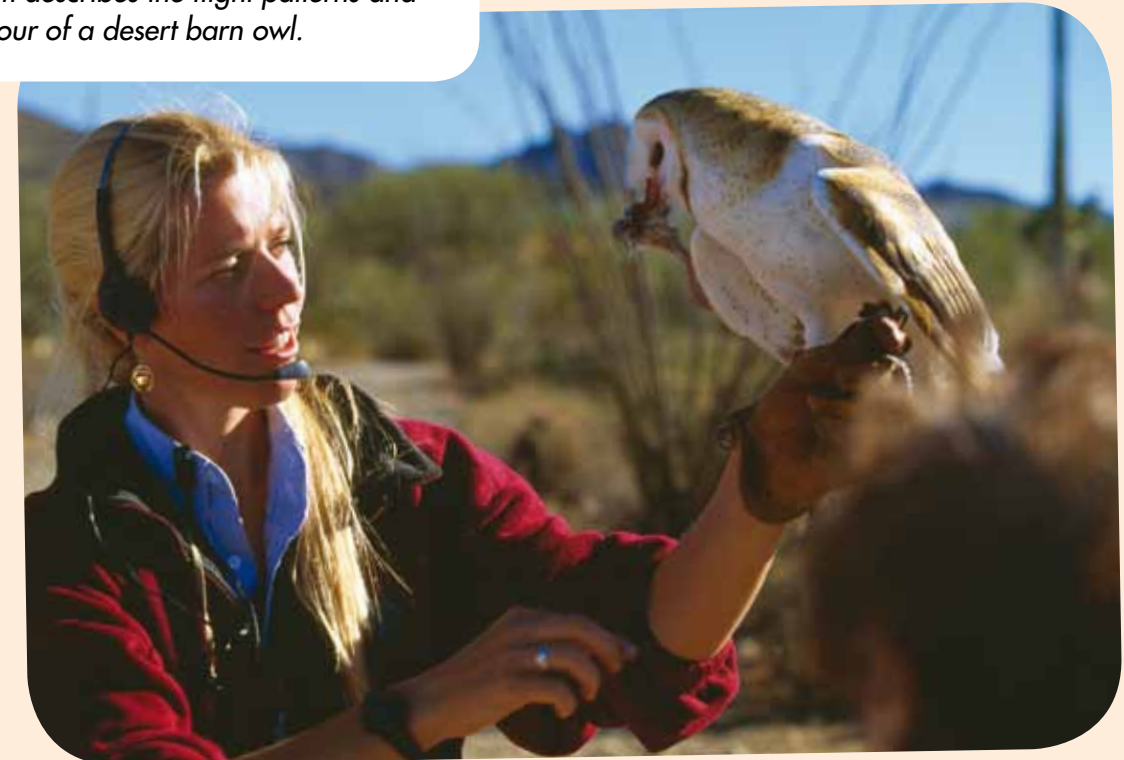
- The Center for Sonoran Desert Studies at the Arizona–Sonora Desert Museum conducts research into desert biodiversity and provides educational material for schools and the public.
- The Sonoran Desert Research Station at Tucson, in Arizona, is run by the United States' Geological Survey and the University of Arizona. It carries out research into desert **ecosystems** and provides information to farmers and local governments about how to protect desert biodiversity.

- The Sonoran Desert Coastal Conservation is a non-profit conservation organisation. It works to establish new reserves in the Mexican Sonoran Desert. These reserves will be positioned so that all habitat types in the desert will be protected.

Did you know?

In 2007, more than 200 fines were issued in Arizona to people who illegally took plants from the Sonoran Desert. The desert has 227 protected plant species. Desert plants, including many cacti, can sell for thousands of dollars.

A scientist at the Arizona–Sonora Desert Museum describes the flight patterns and behaviour of a desert barn owl.



More plant species live in the Sonoran Desert than in any other desert, but only some parts of the desert are protected as national parks and reserves.

What is the future for deserts?

Scientists predict that in the future rainfall will increase in some deserts, such as the Gobi, but decline in others, such as the Sahara. These changes will affect biodiversity. Some desert **species** will thrive, and other species will disappear.

What can you do for deserts?

You can help protect deserts in several ways.

- Find out about deserts. Why are they important and what threatens them?
- Become a responsible consumer. Do not litter, do not waste water and choose plants for your garden that will not escape into the wild.
- If you are concerned about deserts in your area, or beyond, write to or email your local newspaper, your local member of parliament or another politician and tell them your concerns. Know what you want to say, set out your argument, be sure of your facts and ask for a reply.

Useful websites



<http://www.desertmuseum.org/kids>

The Arizona–Sonora Desert Museum website has fact sheets on the Sonoran Desert and its animal and plant species.

<http://www.biodiversityhotspots.org>

This website has information about the richest and most threatened areas of biodiversity on Earth.

<http://www.iucnredlist.org>

The IUCN Red List has information about threatened plant and animal species.

Glossary

adapt change in order to survive

bacteria types of single-celled microscopic organisms

carbon dioxide a colourless and odourless gas produced by plants, animals and the burning of coal and oil

climate the weather conditions in a certain region over a long period of time

ecosystem the living and non-living things in a certain area and the interactions between them

endemic species species found only in a particular area

evolution process by which species change

extinct having no living members

feral wild, especially domestic animals that have gone wild

genes segments of deoxyribonucleic acid (DNA) in the cells of a living thing, which determine characteristics

habitats places where animals, plants or other living things live

heritage things we inherit and pass on to following generations

humus the material in soil that comes from living things

interactions actions that are taken together or that affect each other

invasive species non-native species that spread through habitats

irrigation the supply of water to crops

nutrients chemicals that are used by living things for growth

organisms animals, plants and other living things

outcrops rock formations that are visible above the ground

poachers people who hunt or take wildlife illegally

precipitation rain, snow, hail or sleet that falls to the ground

species a group of animals, plants or other living things that share the same characteristics and can breed with one another

succulent type of plant that has adapted to dry conditions, with a stem or fleshy leaves that can store water

temperate in a region or climate that has mild temperatures

tropical in the hot and humid region between the Tropic of Cancer and the Tropic of Capricorn

urban of towns and cities

urbanisation the development of towns and cities

vegetation plants

Index

A

addax 19
Antarctica 9

B

biodiversity hotspots 14,
15, 30
birds 5, 14, 24, 26

C

camels 17
climate change 22–3
conservation 24–5, 29
Couch's spadefoot toad 13

D

desert grasses 4, 16, 23,
27
desert rat-kangaroo 7
desert types 8

E

ecosystem diversity 4, 6,
8, 9, 11, 12–13
ecosystems 4, 6, 12–13,
20, 24, 29
education 24, 25, 29
endemic species 10, 11,
14, 26
extinct species 5, 6, 7, 17,
19, 22

F

farming 15, 16, 20, 27, 28
fires 10, 22, 23, 27
fish 5, 13, 14, 22, 26
food chains 12
food webs 12

G

genetic diversity 4, 6, 21
grazing animals 15, 16,
17, 25, 27, 28

H

habitats 4, 7, 8, 10, 11,
16, 20, 21, 22, 23, 24,
26, 27, 29
Horn of Africa 14, 15, 18,
19
hunting 10, 15, 18, 19,
21, 27

I

invasive species 7, 16–17,
21, 25, 27
irrigation 15, 20

L

legumes 26
location of deserts 8, 9

M

medicines 6
microhabitats 4
mining 15, 20

N

national parks 25, 28
nutrients 6, 12, 16, 26

O

oryx 19

P

pet trade 18
plant-stealing 15, 18, 29
pollution 14

R

rainfall 11, 13, 22, 26, 30
research 24, 29
reserves 24, 25, 28, 29
roads 20, 21

S

Sonoran Desert 9, 13, 20,
25, 26–9, 30
species diversity 4, 5, 10,
11, 14, 22, 24, 26
Succulent Karoo 14, 15,
18, 20
succulent plants 15, 18

T

temperature increases 22,
23
threats to biodiversity 5,
14–15, 16–17, 18–19,
20–21, 22–3, 24, 26, 27,
30
tortoises 18, 25

U

urbanisation 27, 28

W

war 15, 19
websites 30
wildlife trade 14, 18–19