

children's illustrated encyclopedia

# The Natural World



 Orpheus

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**Created and produced by** Orpheus Books Ltd

**Text** Claire Aston, Steve Parker

**Consultant** Steve Parker BSc Scientific Fellow of the  
Zoological Society

**Illustrators** Susanna Addario, Mike Atkinson, Andrew Beckett, John  
Butler, Martin Camm, Ferruccio Cucchiarini, Elisabetta Ferrero,  
Giuliano Fornari, Andrea Ricciardi di Gaudesi, Gary Hincks, Ian  
Jackson, David More, John Morris, Steve Noon, Nicki Palin, Alessandro  
Rabatti, Eric Robson, Claudia Saraceni, Peter David Scott, Ivan Stalio,  
Colin Woolf, David Wright

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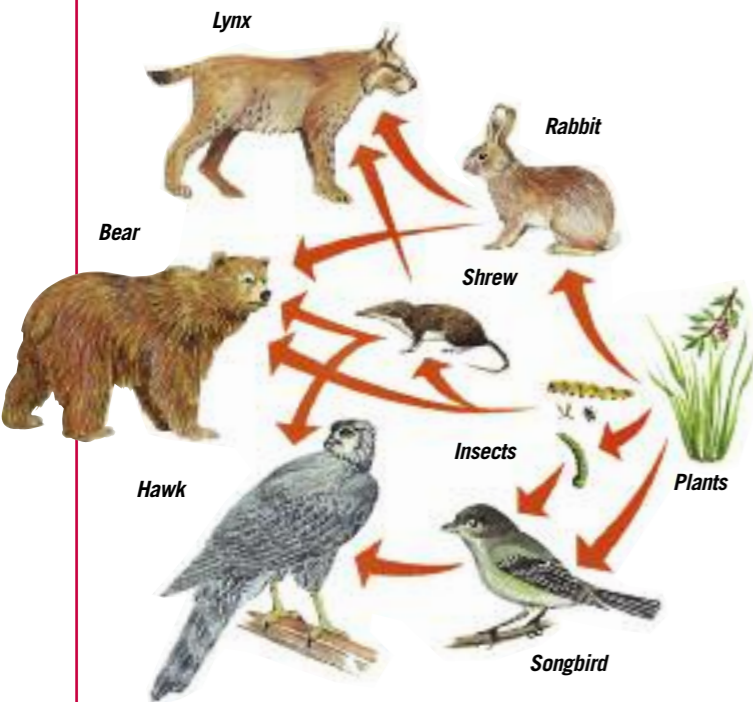
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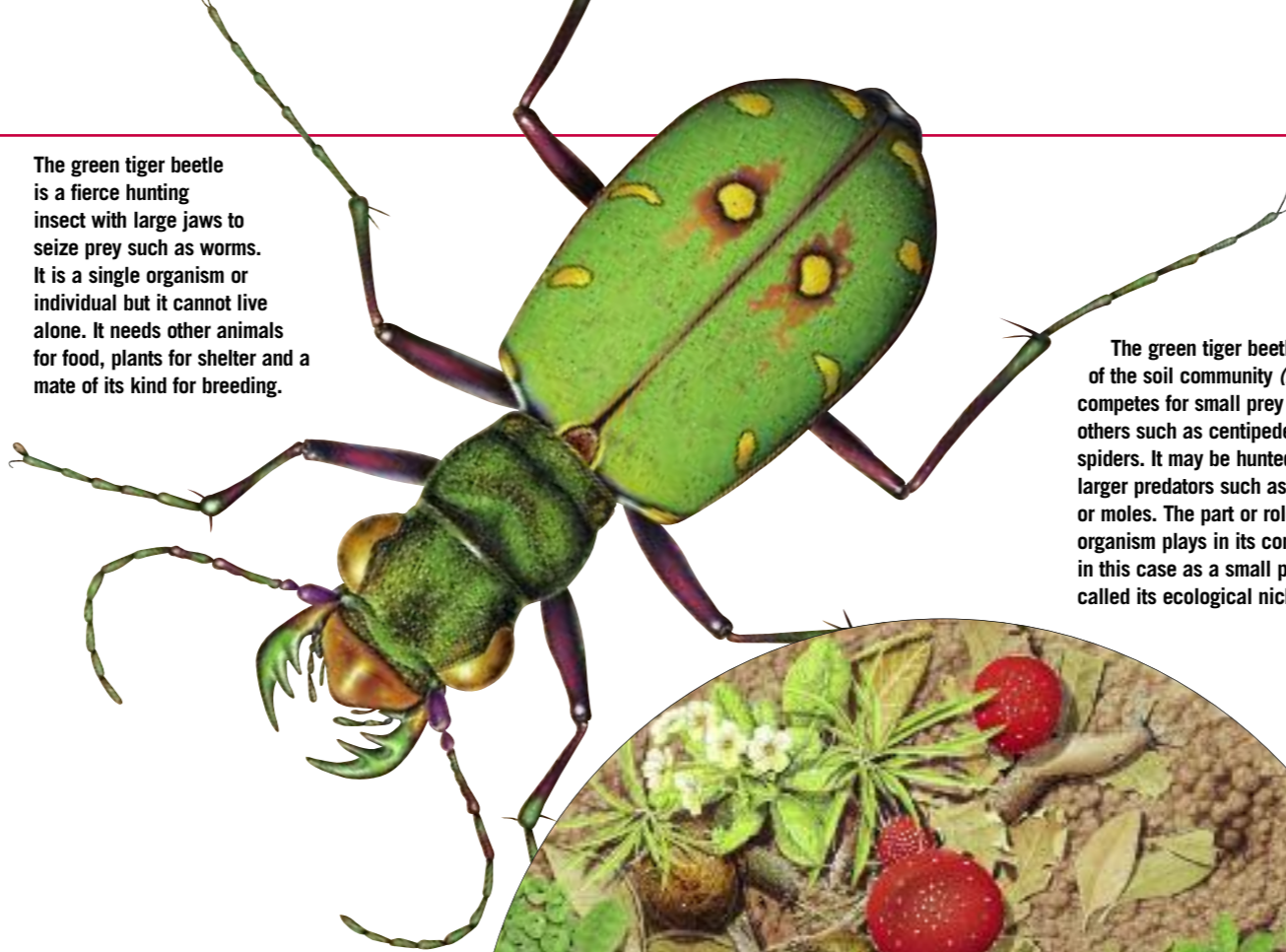
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## ECOLOGY

**T**HE WORD ecology comes from the ancient Greek *oikos* (*ecos*) meaning “house”. It can be thought of as the study of “nature’s house-keeping”. Ecology looks at how animals, plants and other living things survive together. It studies how they depend on and relate to each other, such as being plants and plant-eaters, predators and prey or parasites and hosts. It also examines how living things fit into the environment with their non-living surroundings including air, water, soil and rocks, and how they cope with changing conditions such as weather, climate and seasons.



The green tiger beetle is a fierce hunting insect with large jaws to seize prey such as worms. It is a single organism or individual but it cannot live alone. It needs other animals for food, plants for shelter and a mate of its kind for breeding.

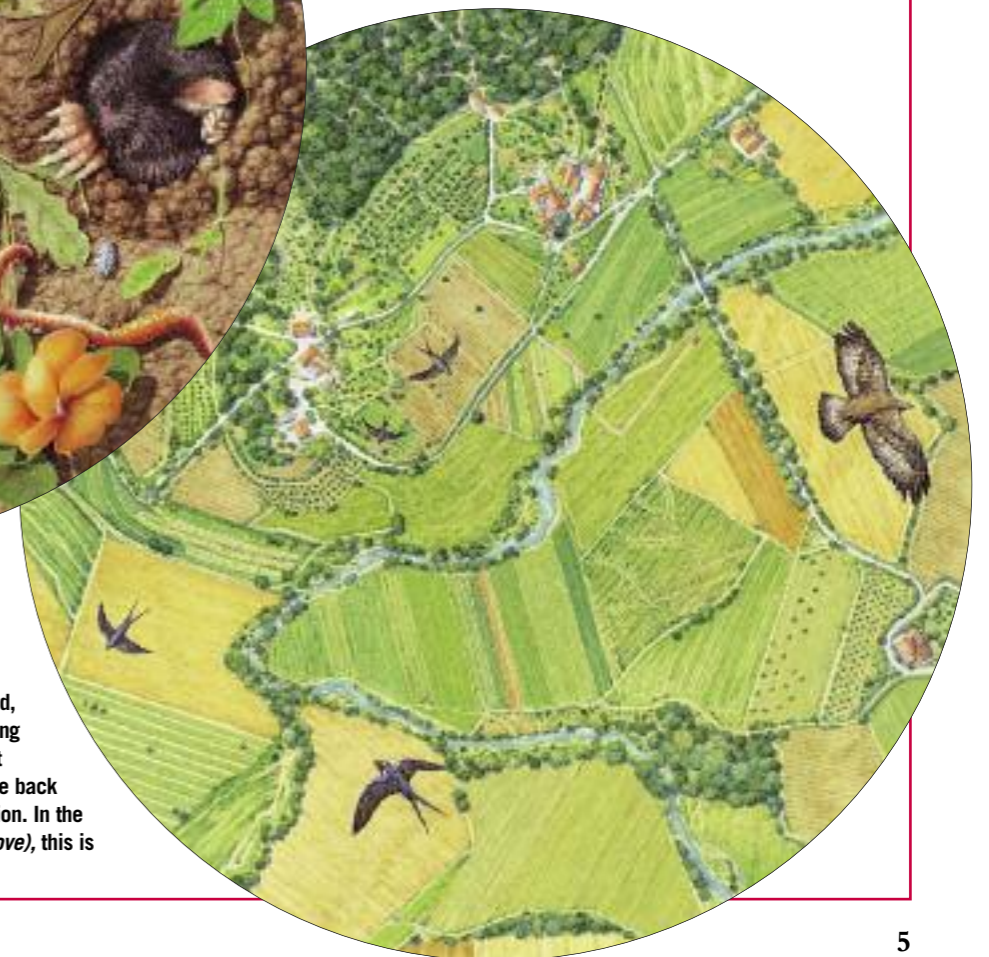


The green tiger beetle is part of the soil community (*below*). It competes for small prey with others such as centipedes and spiders. It may be hunted itself by larger predators such as shrews or moles. The part or role that an organism plays in its community, in this case as a small predator, is called its ecological niche.

One of the most important activities living things do is feeding. Plants “feed” on sunlight and minerals from the soil and form the group known as primary producers. Animals that eat plants form another group, herbivores. They range from tiny insects to rabbits. Animals that eat animals are carnivores. When plants and animals are linked in this way, it is called a food chain. Since animals eat more than one kind of food, food chains are part of more complex food webs, such as this example (*left*) from a North American forest.



Human activities have replaced vast areas of countryside with a mosaic of artificial habitats (*right*). A hedge is like a strip of woodland, while a river has vegetation along its banks. The rest is fields. Left alone, they would slowly change back to the natural habitat of the region. In the case of the soil community (*above*), this is broadleaf woodland.



## COMMUNITY AND HABITAT

The basic part or unit of ecology is an individual organism, such as an animal or plant. Individual organisms hardly ever live on their own. They exist and interact with others, satisfying their needs such as shelter and nourishment. For example, an animal eats part of a plant, then the plant grows using that animal’s droppings as fertilizer.

Living things in an ecosystem that interact and rely on each other for survival, form a community. Their natural homes may be small like a garden pond or a rotting log, or extensive, like a lake or forest. These homes are all different types of habitat, places based on similar kinds of plants or physical features such as soil type. Examples are oak woods, salt marshes, coral reefs, sand dunes or the deep ocean floor. The largest habitats are vast areas known as biomes (*see page 6*).

Ecology is a “new” part of the life sciences. Compared to zoology and botany (the studies of animals and plants), which are thousands of years old, ecology has been carried out in a detailed and serious way for less than one hundred years. It is also a very complex and wide-ranging science, relying on topics such as meteorology (the study of weather and climate) and oceanography. In turn, the basic ideas of ecology are used in related subjects such as farming, pollution control, conservation and countryside care.

Ecology is divided into various specialist areas such as the freshwater ecology of ponds, rivers, lakes and marshes, marine ecology of estuaries, seas and oceans, and terrestrial ecology of the land. Ecologists are interested mainly in what living things—called organisms—do in their surroundings. They think of the natural world as being divided up into ecosystems, distinct areas in which living things interact with their environment. All ecosystems taken together form the biosphere, the living world.

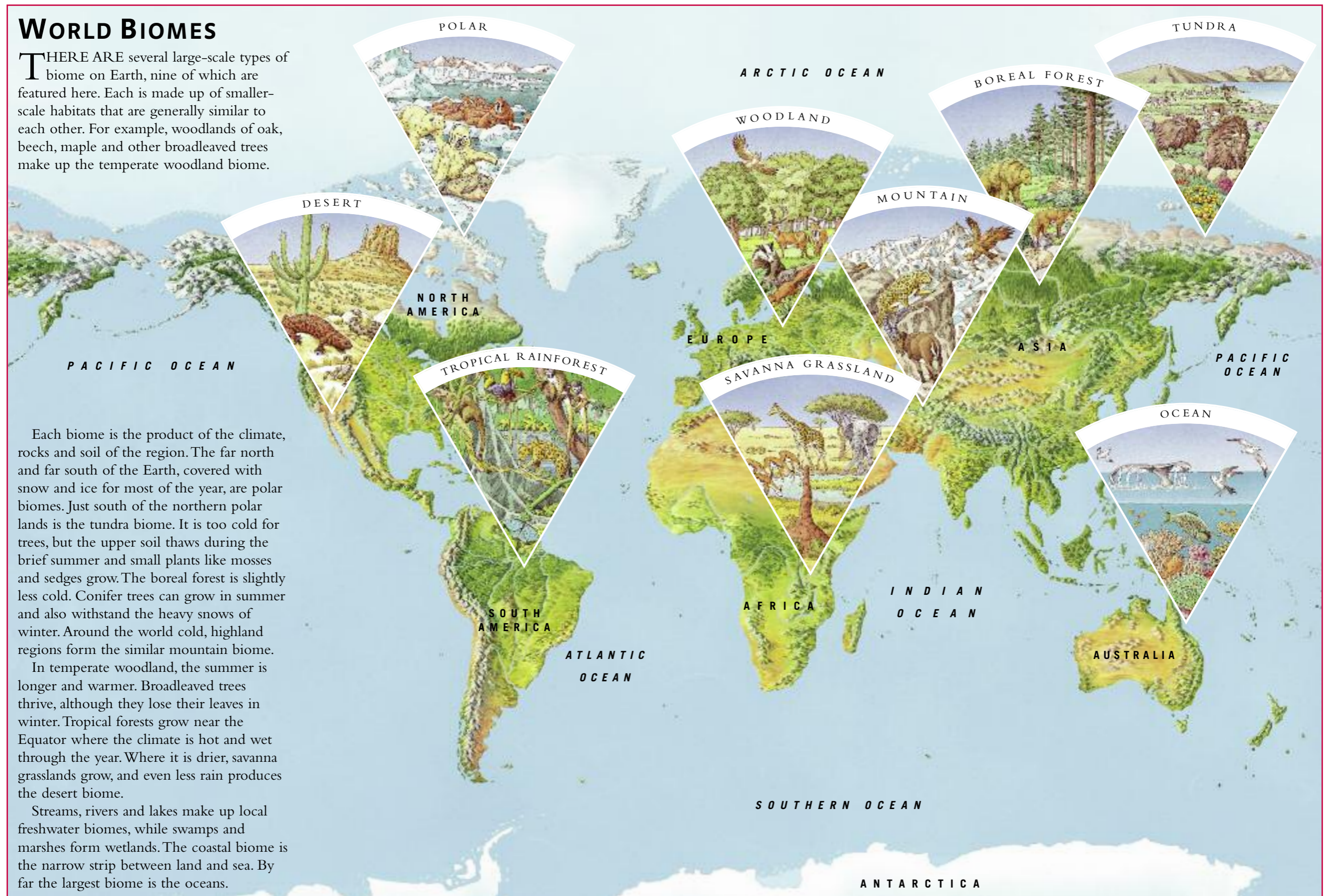
# WORLD BIOMES

**T**HERE ARE several large-scale types of biome on Earth, nine of which are featured here. Each is made up of smaller-scale habitats that are generally similar to each other. For example, woodlands of oak, beech, maple and other broadleaved trees make up the temperate woodland biome.

Each biome is the product of the climate, rocks and soil of the region. The far north and far south of the Earth, covered with snow and ice for most of the year, are polar biomes. Just south of the northern polar lands is the tundra biome. It is too cold for trees, but the upper soil thaws during the brief summer and small plants like mosses and sedges grow. The boreal forest is slightly less cold. Conifer trees can grow in summer and also withstand the heavy snows of winter. Around the world cold, highland regions form the similar mountain biome.

In temperate woodland, the summer is longer and warmer. Broadleaved trees thrive, although they lose their leaves in winter. Tropical forests grow near the Equator where the climate is hot and wet through the year. Where it is drier, savanna grasslands grow, and even less rain produces the desert biome.

Streams, rivers and lakes make up local freshwater biomes, while swamps and marshes form wetlands. The coastal biome is the narrow strip between land and sea. By far the largest biome is the oceans.

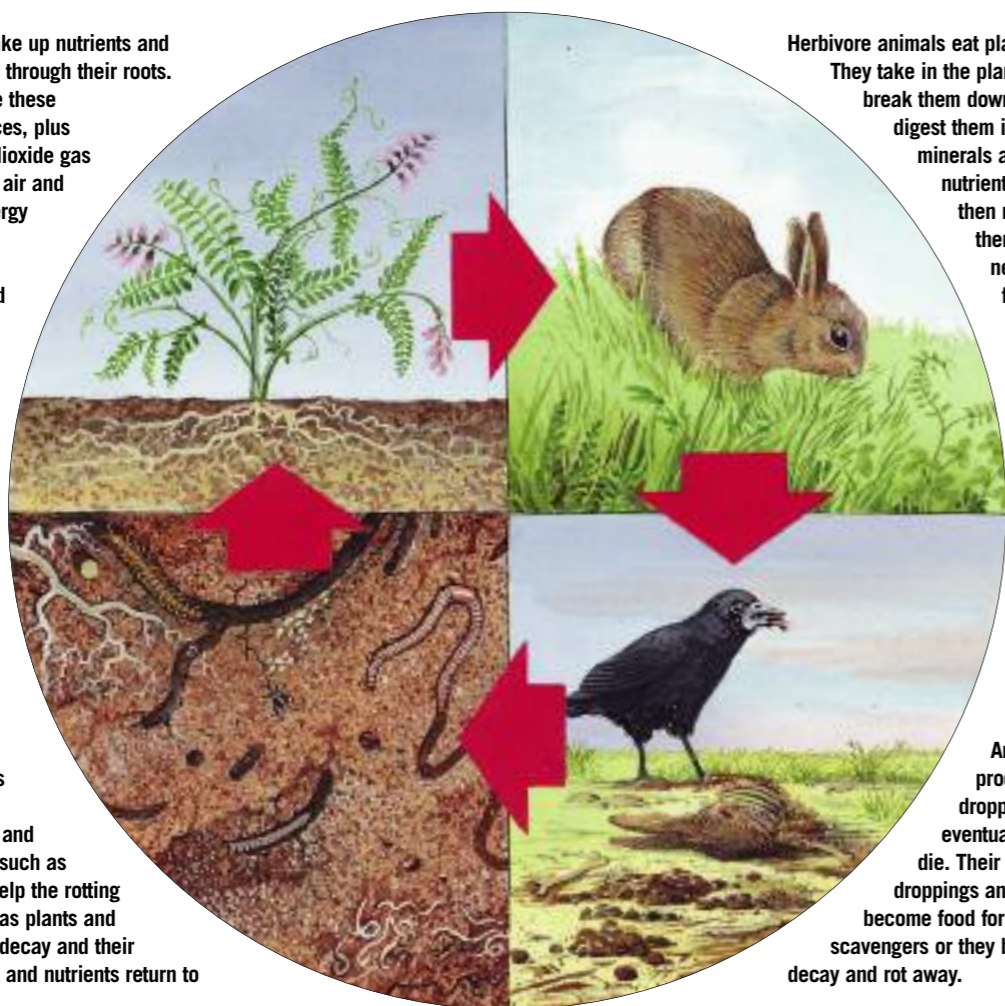


## NATURAL CYCLES

PLANET EARTH is like a giant, self-contained spaceship. It only has a limited amount of chemical substances and other matter. In nature these chemical elements such as oxygen, carbon and sulphur are neither made nor destroyed. They are recycled, moving round and round in the natural world in the form of minerals and nutrients. The number of separate pathways and short-cuts is almost endless. But, in general, minerals and nutrients move from the soil into plants, into plant-eating animals or herbivores, then meat-eating animals or carnivores, back into the soil when any plant or animal dies and rots away, and so on. At any time the pathway may branch off, for example, when a scavenger feasts on a rotting animal carcass.

One of the most important chemical substances in nature is carbon. It forms the basis of the building-block molecules of living things, from microscopic cells to our own teeth and hair. In the **carbon cycle**, carbon in the form of carbon dioxide gas in the air is taken in by plants during the process of photosynthesis and used to build their body parts. Animals eat the plants and re-arrange the carbon-based substances to make and maintain their own body parts. At the same time they break down high-energy, carbon-containing substances such as sugars in their bodies, by the process of respiration, to gain energy for their life processes. The respiration combines the carbon from sugar with the oxygen they breathe in to make carbon dioxide gas. This is breathed out into the air—and so the carbon cycle continues.

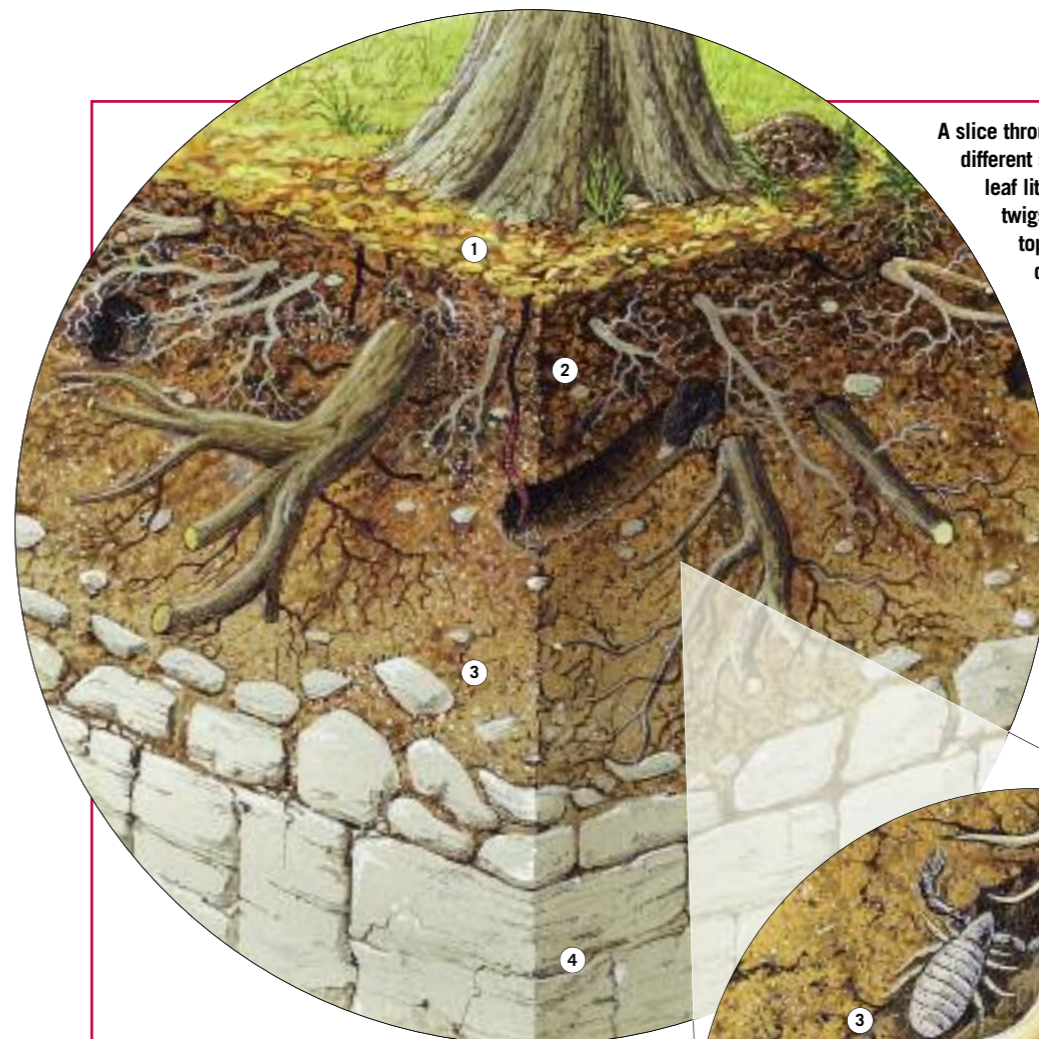
Plants take up nutrients and minerals through their roots. They use these substances, plus carbon dioxide gas from the air and light energy from the Sun, to grow and make new parts.



Herbivore animals eat plants. They take in the plant parts, break them down or digest them into minerals and nutrients, and then recycle them to form new parts for their own bodies.

Fungi, microbes such as bacteria and animals such as worms help the rotting process as plants and animals decay and their minerals and nutrients return to the soil.

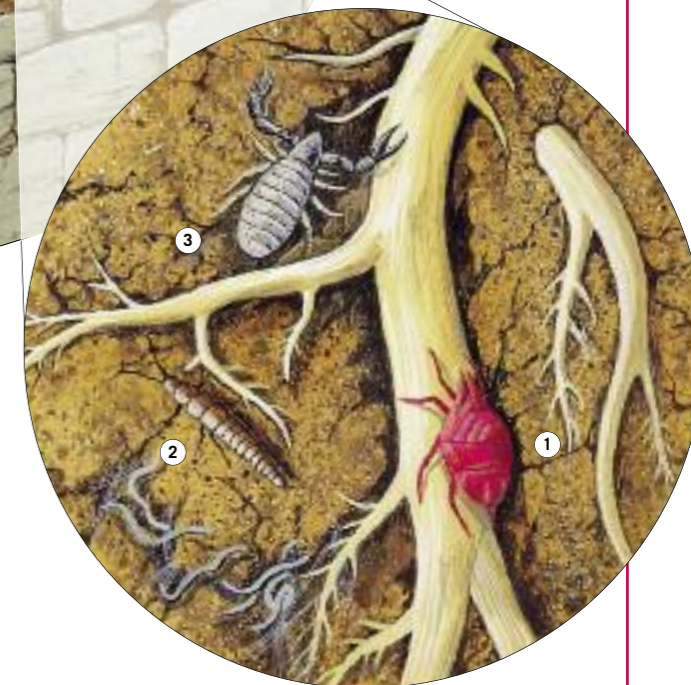
Animals produce droppings and eventually they die. Their droppings and bodies become food for scavengers or they begin to decay and rot away.



A slice through the ground reveals the different soil layers (left). On top is leaf litter (1) with old leaves, twigs and feathers. Below is topsoil (2), rich in dead and decaying remains of plants and animals and home to small soil creatures. It also contains the thin roots of small plants. Next is the subsoil (3). This has less organic matter, and more and larger rock fragments. The roots of bushes and trees grow into the subsoil for firm anchorage. The rock fragments get bigger and more numerous until they form solid bedrock (4).

## SOIL

SOIL may appear dull and lifeless, but it is a vital part of the natural world. Soil consists of fragments of rock, such as sand grains, mixed with the rotting remains of leaves, animal droppings and other plant and animal matter. Water and air occupy the spaces between the soil particles. Also inhabiting the soil are millions of microscopic living things, such as bacteria, tiny animals like mites and springtails, the roots of growing seeds and full-grown plants, the threads of fungi, small creatures such as earthworms and insect grubs, and larger animals like moles. Soils vary enormously in their thickness, particle size and the main minerals and nutrients they contain. The climate, the kinds of rocks that lie beneath and the main types of plants that grow in soil all affect its character and its nourishing ability, or fertility.



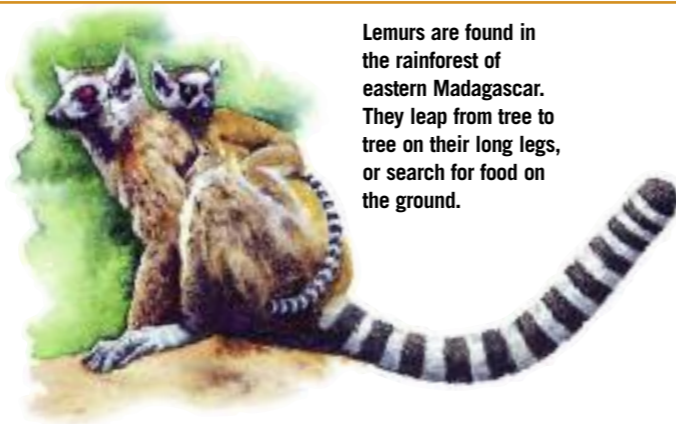
Tiny red mites (1), springtails (2) and false scorpions (3) teem in their millions in soil among the plant roots.

Deep soil with plenty of rotting plant and animal matter is very fertile and many plants grow in it. But specialist plants like cacti can grow even in thin, dry, nutrient-poor, sandy desert soils. Sadly, acid rain caused by pollution has made large areas of soil too acid to support much life.

# TROPICAL RAINFOREST

**A**REAS OF tropical rainforest are found near the Equator, in regions with a hot climate and high level of rainfall all year round. The most extensive rainforests are found in Central Africa, South America, Southeast Asia and the island of Madagascar. There are also small areas of rainforest in Australia and Central America.

Tropical rainforests are the richest of all environments in terms of plant and animal life. Today, large areas of rainforest are being cut down, both to supply the timber industry and to make room for farming, roads, quarries and housing.



Lemurs are found in the rainforest of eastern Madagascar. They leap from tree to tree on their long legs, or search for food on the ground.

fruits and flowers. Below the emergent layer is the canopy, an almost continuous “roof” of branches and foliage. Here, in the warm sunlight, fruits and flowers grow, and many animals feed on them.

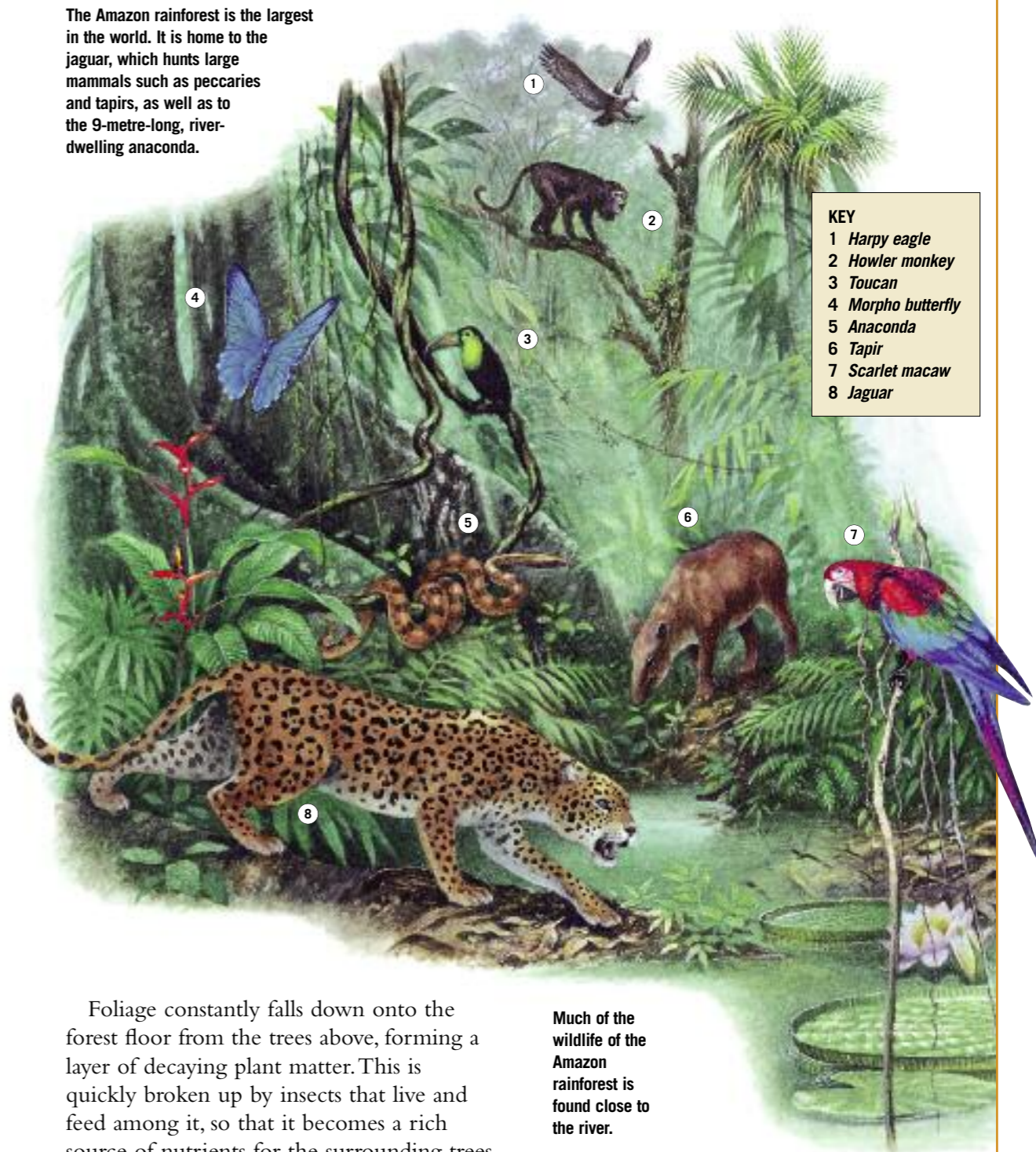
Lower still is a shadier area known as the understorey, where animals fly, leap, climb or glide between the trees. Smaller plants that could not survive on the dark forest floor root themselves in pockets of decaying matter among branches, using the trees as a support to reach up towards the light.



The mandrill, a kind of baboon, lives on the floor of the Central African rainforest.

At the level of the forest floor, little light can penetrate down through the thick canopy. The atmosphere is dark and still, and ground vegetation is scarce. Only in places where a tree has fallen to create a clearing, or along the banks of a river, can ground vegetation find enough light to to grow.

The Amazon rainforest is the largest in the world. It is home to the jaguar, which hunts large mammals such as peccaries and tapirs, as well as to the 9-metre-long, river-dwelling anaconda.

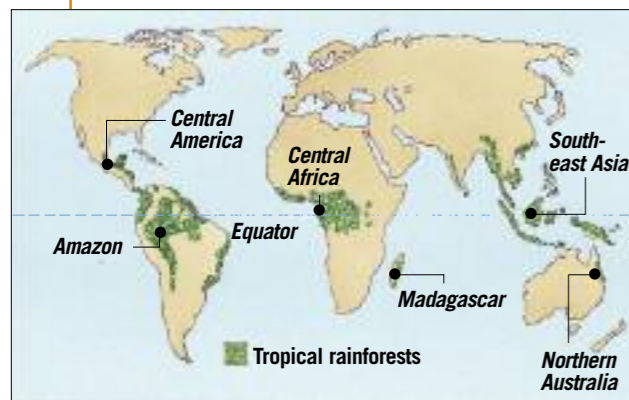


- KEY**
- 1 *Harpy eagle*
  - 2 *Howler monkey*
  - 3 *Toucan*
  - 4 *Morpho butterfly*
  - 5 *Anaconda*
  - 6 *Tapir*
  - 7 *Scarlet macaw*
  - 8 *Jaguar*

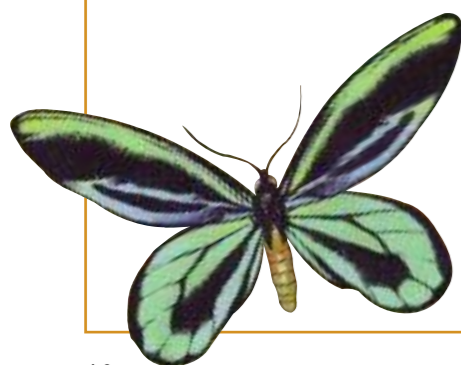
Much of the wildlife of the Amazon rainforest is found close to the river.

Foliage constantly falls down onto the forest floor from the trees above, forming a layer of decaying plant matter. This is quickly broken up by insects that live and feed among it, so that it becomes a rich source of nutrients for the surrounding trees to take into their roots. The insects themselves are food for birds and ground-dwelling forest animals, such as rodents and lizards. These small animals are, in turn, hunted by larger predators, such as snakes and cats, some of which will often lie in wait on low branches, ready to drop down on to their unsuspecting prey.

Large plant-eaters such as elephants and gorillas also feed on the forest floor, pulling foliage from the lower branches. Rivers full of fish run through the forests, and are sources of food and water for many animals. Some animals, like the capybara, also leap into the water to escape from predators.



The rainforest is made up of several different layers, like the storeys of a skyscraper. At the highest level is the emergent layer, made up of the tallest trees, some of which can reach 70 metres in height. This is a bright, windy layer, where birds and bats swoop, feeding on insects,



There are millions of insects in tropical rainforests. Many kinds are as yet unidentified. Some, such as the Queen Alexandra's birdwing butterfly (left), grow to enormous sizes.

# RAINFOREST CANOPY

THE CANOPY is where most birds, insects, monkeys and other rainforest animals live. Many plants, called epiphytes, grow in the moss collected in tree branches. This illustration is of the Southeast Asian rainforest.

- KEY**
- 1 Crested swift
  - 2 Whiskered tree swift
  - 3 Red-bearded bee-eater
  - 4 Great hornbill
  - 5 Colugo
  - 6 Siamang gibbon
  - 7 Fruit bat
  - 8 Great Memnon butterfly
  - 9 Blue-rumped parrot

Insect-eating birds such as swifts and bee-eaters perch on the topmost branches, ready to swoop down and catch their prey in mid-air. The heavier hornbill sits on lower branches, feeding on fruits.

The continuous network of branches in the canopy means that some animals hardly ever descend to the ground. There is plenty of food in the form of fruits and leaves, as well as insects and other small prey. To move from branch to branch, colugos spread out flaps of skin along their sides and glide. Gibbons have very long arms and strong, grasping hands and feet. They swing through the trees with a smooth, hand-over-hand movement known as brachiation.

The year-round supply of fruit and flowers provides a feast for fruit bats. While feeding on flower nectar, they also play a part in the process of pollination, as their fur becomes dusted with pollen which is then carried to another flower.

The rainforest canopy is alive with colour, provided not only by the fruits and flowers, but also by many brightly-coloured animals. Huge butterflies flap through the trees, so large that they could almost be mistaken for birds. Groups of noisy parrots provide vivid splashes of colour as they search for nuts to crack with their strong beaks.



# AMAZON RIVER LIFE

THE AMAZON RIVER has thousands of tributaries that flow through the rainforest. Some of these channels are wide and deep, while others are narrow, shallow and full of fallen leaves, branches, and winding tree roots. The river teems with fish, including predators such as the notorious piranha, the electric eel and the arawana, which will often leap out of the water to snatch insects or even birds.

- KEY**
- 1 Piranhas
  - 2 Electric eel
  - 3 Jacana
  - 4 Striped leporinus
  - 5 Arawana
  - 6 Hummingbirds
  - 7 Postman butterfly
  - 8 Bromeliad
  - 9 Angelfish
  - 10 Hyacinth macaw
  - 11 Owl butterfly
  - 12 Amazon kingfisher
  - 13 Tetras
  - 14 Bird-eating spider
  - 15 Leafcutter ants
  - 16 Sunbittern
  - 17 Pirarucu

The river is the hunting ground of birds such as the jacana and the sunbittern. The jacana can walk across floating water plants without sinking, while the sunbittern wades through the muddy shallows, probing for insects and small fish with its long beak. The Amazon kingfisher sits on an overhanging branch. In a flash, it dives into the water, emerging with a fish which it takes back to the branch to eat.

The river channels also provide a rich source of food and water for land-dwelling animals and the peoples of the Amazon. During the rainy season, vast areas of the forest floor flood, and fish swim among the tree trunks. Some animals, such as the capybara, anaconda or jaguar, are good swimmers and are easily able to negotiate the floodplains. Other animals, such as monkeys, iguanas and anteaters, take to the trees during the floods.

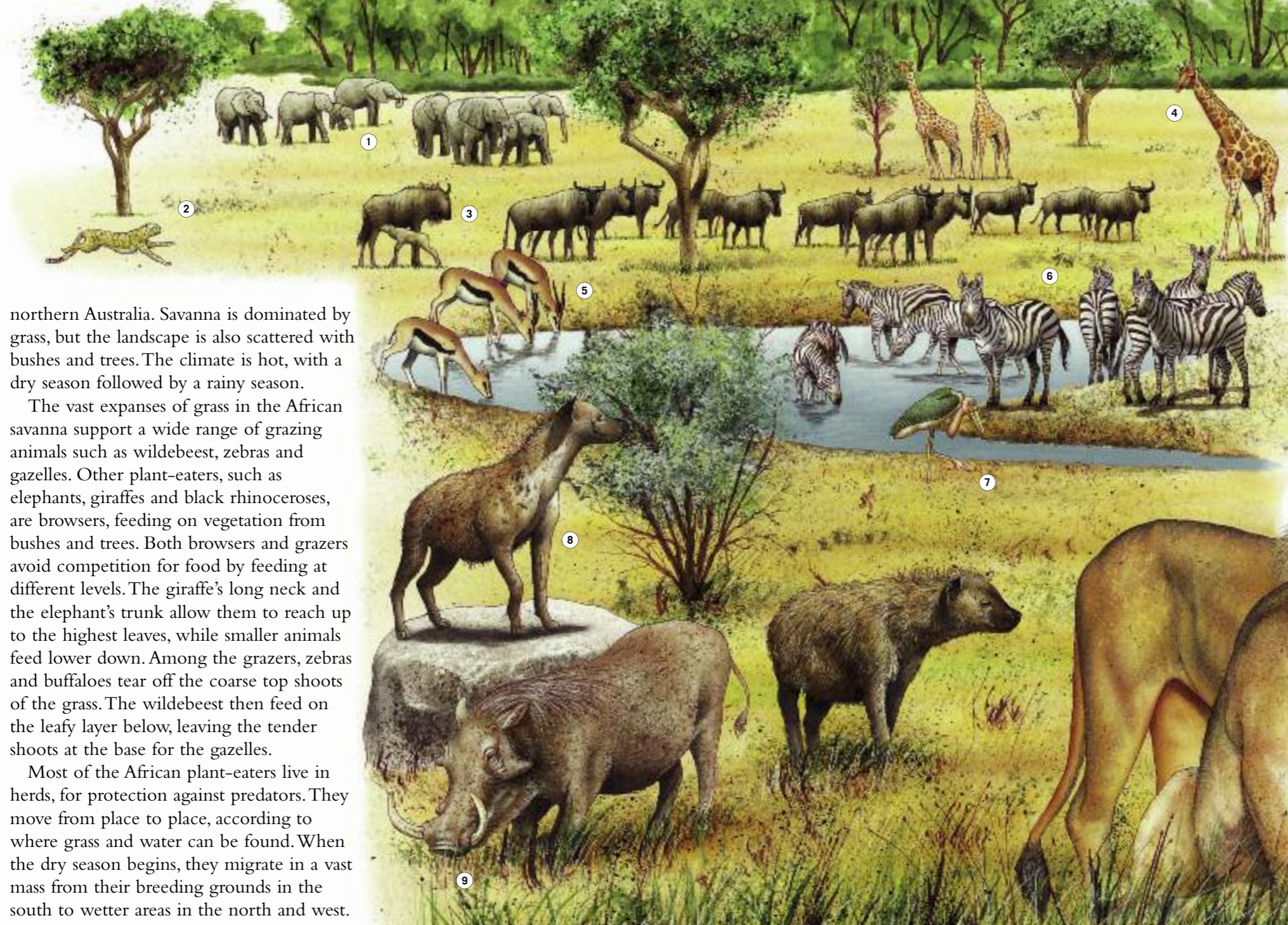




## SAVANNA

SAVANNA grasslands are found close to the Equator, outside the belt of tropical rainforests. The largest and best-known savanna grasslands are in Africa, although there are also areas in South America, India and

KEY		
1 Elephant	6 Zebra	9 Warthog
2 Cheetah	7 Marabou stork	10 Lion
3 Wildebeest	8 Hyena	
4 Giraffe		
5 Thomson's gazelle		



northern Australia. Savanna is dominated by grass, but the landscape is also scattered with bushes and trees. The climate is hot, with a dry season followed by a rainy season.

The vast expanses of grass in the African savanna support a wide range of grazing animals such as wildebeest, zebras and gazelles. Other plant-eaters, such as elephants, giraffes and black rhinoceroses, are browsers, feeding on vegetation from bushes and trees. Both browsers and grazers avoid competition for food by feeding at different levels. The giraffe's long neck and the elephant's trunk allow them to reach up to the highest leaves, while smaller animals feed lower down. Among the grazers, zebras and buffaloes tear off the coarse top shoots of the grass. The wildebeest then feed on the leafy layer below, leaving the tender shoots at the base for the gazelles.

Most of the African plant-eaters live in herds, for protection against predators. They move from place to place, according to where grass and water can be found. When the dry season begins, they migrate in a vast mass from their breeding grounds in the south to wetter areas in the north and west.

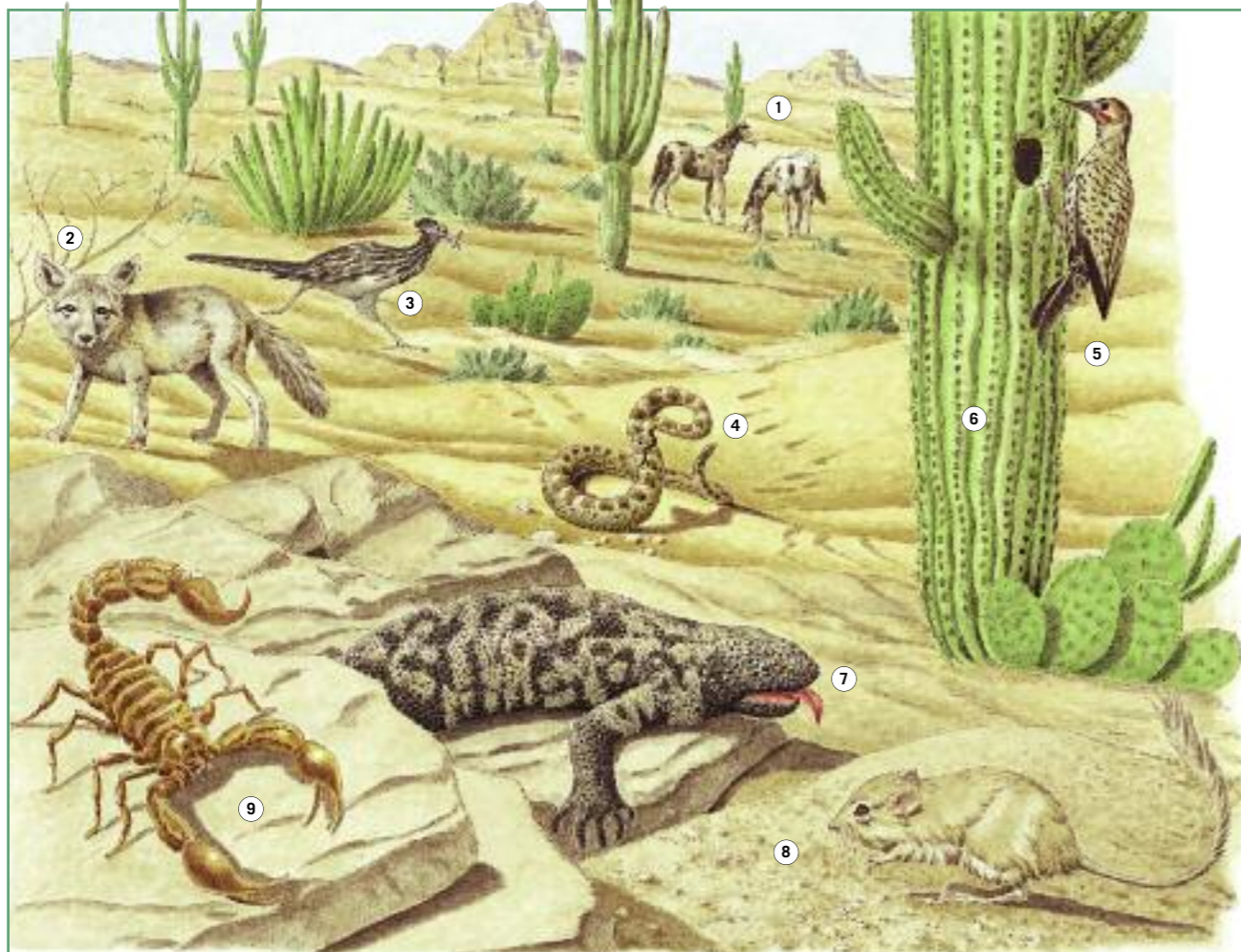
## HUNTERS AND SCAVENGERS

The herds of plant-eaters provide food for many savanna carnivores, including lions, leopards, cheetahs, hyenas and wild dogs. The larger carnivores can kill large plant-eaters such as wildebeest. Smaller, less powerful hunters feed on antelopes and gazelles, rodents and other small animals. Birds of prey swoop down on their victims out of the sky, or from treetops.

After the hunters have eaten their fill, the scavengers move in. As well as making their own kills, hyenas scavenge from the remains of others, their strong jaws able to crush even bones. Vultures spot the carcass as they circle in the skies, and come down to feed, drawing the attention of other scavengers, marabou storks and jackals. The final scraps are removed by flies and beetles.

Insects are very important to life on the savanna, especially in this "clearing up" process. Dung beetles remove animal dung, on which they feed and lay their eggs. Termites take dead plant matter into their nests, where they grow fungus on it to eat.

Among the top predators of the African savanna are lions. A group, or pride, of lions is mostly made up of females and their young. At the head of the pride is one male, or several related males. The females do most of the hunting, while the males defend the pride's territory. Rival males often battle with each other fiercely for control of a pride.



“Living stones” are southern African desert plants. They have very thick leaves with a waxy surface to prevent as little water as possible being lost from them. This means that they can store large amounts of water in their leaves. They live among rocks, taking in any water that seeps into the rock crevices. To avoid being eaten by thirsty animals, these plants have evolved shapes and colours which, when they are not in flower, make them look very much like the surrounding rocks.



The addax is a large antelope from the Sahara desert. Its light-coloured coat reflects heat, while its digestive system can cope with coarse grasses and little or no water.



Despite the barren landscape, a surprising variety of animal life can be found in the desert. The biggest problems facing these animals are the heat and the lack of water. Small mammals such as kangaroo rats and ground squirrels spend the day sheltering from the hot sun underground, coming out to feed only at night. Reptiles, on the other hand, need to warm up in the sun before they can become active enough to hunt, so they cannot feed at night. Instead, they shelter in burrows or rock crevices during

the hottest part of the day, basking and feeding during the cooler early morning and evening.

Some large mammals, such as camels, have thick coats on their backs to keep out the heat, and thinner hair on their bellies which lets excess heat out of the body. They can also conserve water inside their bodies, needing to take in very little to survive. Some carnivorous animals get all the water they need from their food, while birds can fly long distances in search of water.

## DESERTS

WITH LITTLE or no rainfall, and often searingly hot temperatures, deserts are some of the most inhospitable places on Earth. Some deserts, especially those close to the Equator, are hot all year round, with temperatures sometimes reaching 50°C. Others, such as the Gobi desert in Mongolia, are cold and windswept. There, high mountains act as a barrier to any warm, moist air currents, and temperatures can fall to -20°C in winter.

Many deserts are bare and rocky with areas of sparse scrubland, where only the hardiest plants can grow. As plants need water to survive, they must conserve as much as they can. Desert plants such as cacti have adapted the way they carry out photosynthesis, opening their stomata (pores) to take in carbon dioxide only in

North American deserts are scattered with cacti, some kinds of which can grow up to 15 m in height. Small mammals emerge from their burrows at night to feed, and are themselves hunted by large lizards and snakes. Wild horses roam the deserts, visiting waterholes to drink.

### KEY

- 1 Wild horses
- 2 Kit fox
- 3 Roadrunner
- 4 Sidewinder
- 5 Gila woodpecker
- 6 Saguaro cactus
- 7 Gila monster
- 8 Kangaroo rat
- 9 Scorpion

the cool of the night. Their thick, swollen stems also help to reduce water loss. Other desert plants keep most of their bulk in root systems underground, out of the sun's heat.

Some hot deserts are sandy, and the wind sweeps the sand into huge wave-like dunes. In these arid, bare landscapes, the sand is mostly too unstable to support plant life. Sometimes an underground water source comes close to the surface, creating an oasis, where plants can grow, and people can live.

Flowering heathland borders the scrubland desert or “outback” of Australia, where honey possums sip flower nectar with their brush-like tongues.



## GRASSLANDS

AREAS OF grassland are found in the continental interior, far from the cool, moist winds of coastal areas. This gives them a warm, dry climate in summer, but many also endure cold winters. Because of the lack of rain in the summer, hardy grasses are the main plant life, though trees can also be found where water gathers during spring. The steppes of Asia and the prairies and pampas of North and South America are dominated by grasses, while the African savanna and Australian grasslands, with their tropical climates, have more trees.

Eucalyptus trees (right) are found in the Australian grasslands. In the hot, dry conditions, many trees are destroyed by fire, but eucalyptus trees are able to re-grow quickly from dormant buds "stored" in their bark.

Grassland animals from four continents (below). The pronghorn of North America, ostrich from Africa and kangaroo from Australia rely on speed to escape from predators, but the armadillo of South America has protective armour-plating.



Baobab trees of Africa (below) survive the dry season by storing water inside their huge, bottle-shaped trunks. They can measure 50 m around their girth.



Grasslands all over the world make ideal environments for plant-eating animals of all sizes, from huge bison to small rodents. The large grazing animals are preyed upon by wolves, coyotes, foxes and other members of the dog family. Even swift kangaroos sometimes fall victim to packs of wild dogs called dingoes. Smaller plant-eaters, such as rabbits or prairie dogs, are a quick meal for larger hunters, but are also hunted by weasels, badgers and birds of prey.

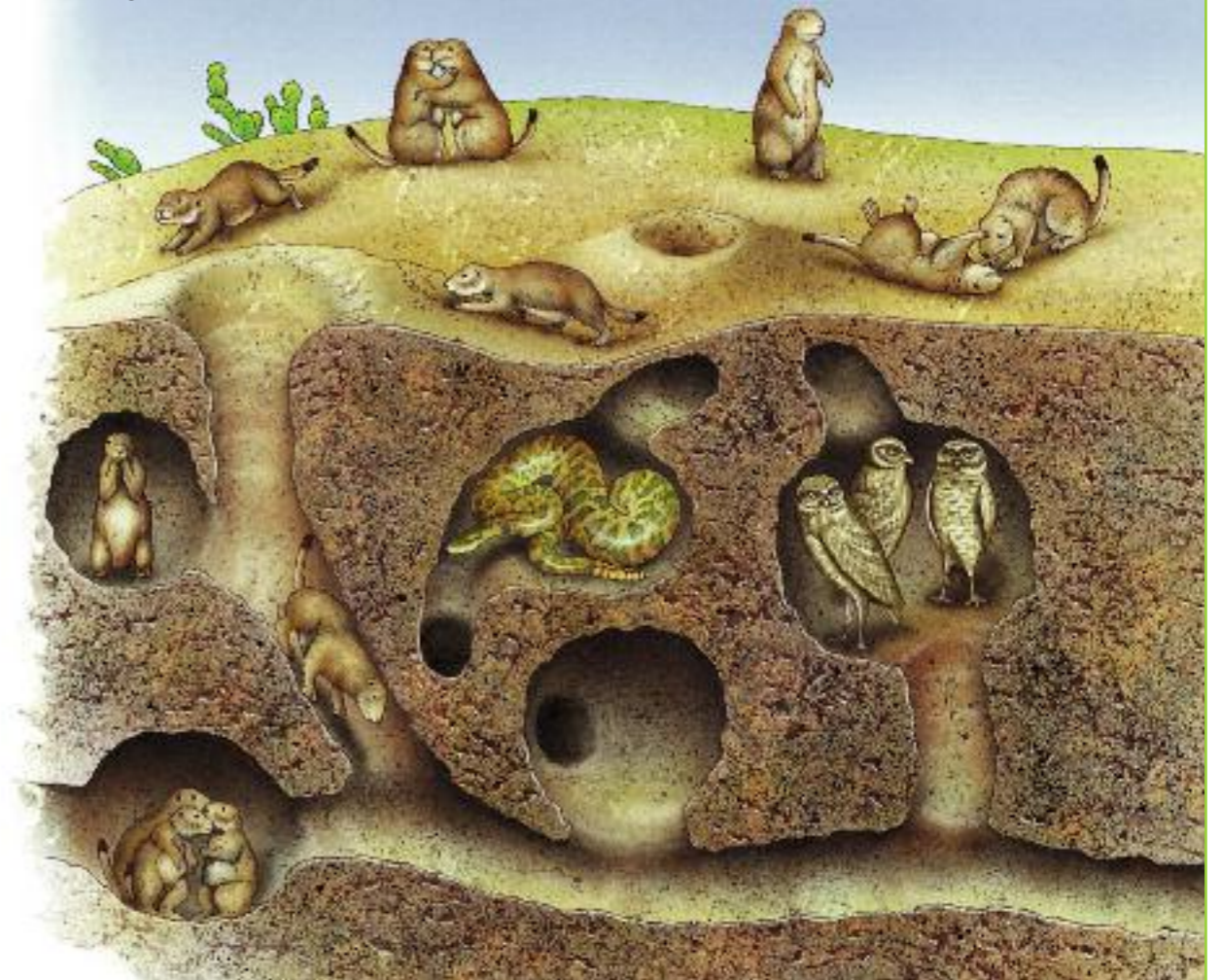
## BELOW GROUND

On the open grassland, where there are few places to hide, the larger grassland animals protect themselves against predators by living in herds. Others rely on speed to carry them away from danger. For the smaller animals, however, the best defence is to live underground. Rabbits, ground squirrels and cavies burrow networks of holes and tunnels, which they use to sleep in, to escape from predators, and to keep their young safe. As they dig, they also help to mix the nutrients in the soil, and keep the grassland healthy.

In the warm summer months, new varieties of flowering plants and grasses grow on the grasslands, attracting many insects. These provide extra food for small mammals such as ground squirrels, as well as for animals that are primarily insect-eaters, such as armadillos.

During the past hundred years or so, large areas of grassland have been destroyed by humans. This is most evident in North America, where the prairies have been greatly damaged and reduced in size by crop and cattle farming. Animals such as the North American bison and its European relative were hunted almost to extinction.

Prairie dogs, a kind of ground squirrel, live on the North American prairies, in colonies sometimes numbering hundreds of animals. While feeding on the surface, they will bark at the sight of a predator such as a coyote or bird of prey. Old burrows are often used by other animals such as burrowing owls and rattlesnakes.



## WOODLANDS

WOODLANDS are found in parts of the world that have a temperate climate, with warm summers but cool winters. In western Europe, the eastern USA and eastern Asia, woodland is mainly deciduous. In winter, the trees lose their leaves and shut down their growth. This



- KEY**
- 1 Red squirrel
  - 2 Green woodpecker
  - 3 Tawny owl
  - 4 Dormouse
  - 5 Roe deer
  - 6 Grey squirrel
  - 7 Jay
  - 8 Badger
  - 9 Rabbit
  - 10 Stoat
  - 11 Blackbird
  - 12 Great tit
  - 13 Song thrush
  - 14 Fox
  - 15 Hedgehog

Autumn in European deciduous woodland (*below*). Hedgehogs and dormice feed before hibernating, while squirrels and jays store nuts for the winter. Owls and foxes look out for prey.

allows them to conserve water and survive the cold. Further north are the coniferous, or boreal, forests of Russia and North America. Their trees have needle-like leaves and a conical shape, to shed heavy snow that could break their branches.

The plants and animals that live in the woodlands also have to survive the winter. Food becomes scarce as plants die back and fruits and seeds are no longer abundant. Some animals hibernate in sheltered tree holes or underground burrows, only stirring with the new growth of spring. Others store enough food during the autumn to last them through the winter.

Unlike the dense roof of a tropical rainforest, the canopy of a deciduous wood lets some light reach the woodland floor, creating a layer of thick, varied ground vegetation. In damp areas, rich green moss coats the trees.

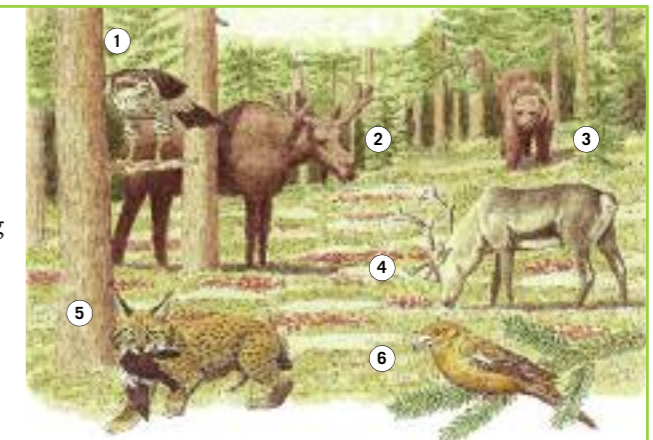
During autumn, fallen leaves build up into a thick layer on the ground, providing insects, worms and small mammals with a warm hibernation site. There is always danger, however, from digging predators such as foxes. In the spring, insects and other invertebrates feed on the leaf litter, breaking it down into nutrients in the soil, where it is taken up by growing plants.

## CONIFEROUS WOODLANDS

Conifers constantly lose and replace their leaves, or needles, throughout the year. The dead leaves are not broken down into the soil because worms and other soil-enriching invertebrates find them distastful. Instead, they remain as a thick layer of leaf litter, making the soil acidic and poor.

Forest berries and fungi provide food for birds and mammals. Crossbills use their specially adapted beaks to prise open pine cones and reach the nutritious seeds inside. Conifer trees provide animals with shelter and some warmth during the winter.

At one time woodlands covered huge areas of Europe, North America and Asia. Much deciduous woodland has been cut down to grow crops on its rich soil. Areas of coniferous forest, with its poor soil, still remain in Asia and North America.

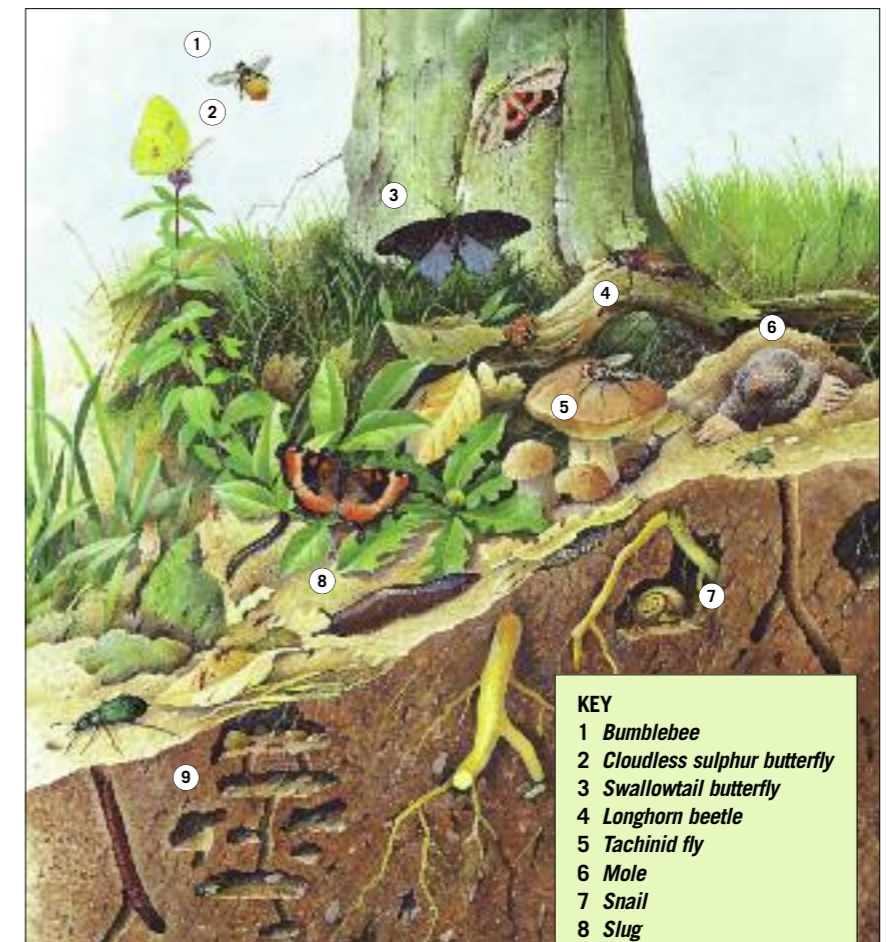


The vast coniferous forests of northern Russia are known as the taiga. During the winter, animals that feed on the northern tundra during the short summer, such as elk and reindeer, shelter in the forest, scraping away the snow to feed on mosses. The lynx and goshawk prey on small mammals. The brown bear hibernates until spring.

- KEY**
- 1 Goshawk
  - 2 Elk
  - 3 Brown bear
  - 4 Reindeer
  - 5 Lynx
  - 6 Crossbill

A woodland may seem to be a calm, quiet place, but, studied closely, it is a hive of activity. A deciduous woodland during the spring and summer months (*right*) is particularly busy. The newly-emerged leaves on the trees are food for insects and their young. Insects also feed on leaf litter on the ground, decomposing it and turning it into a rich mixture of nutrients. Butterflies and bees visit flowers to drink nectar. As they feed, bees also carry pollen from one flower to another, helping the flowers to reproduce. Birds and mammals also help in plant reproduction, by feeding on fruits and discarding the seeds on the ground.

Below ground, worms feed on the soil, mixing and breaking it down. Predators such as moles dig through the soil after them with their powerful feet. Ants leave their nest chambers to search for food on the surface.



- KEY**
- 1 Bumblebee
  - 2 Cloudless sulphur butterfly
  - 3 Swallowtail butterfly
  - 4 Longhorn beetle
  - 5 Tachinid fly
  - 6 Mole
  - 7 Snail
  - 8 Slug
  - 9 Ants

## RIVER LIFE

RIVERS hold a very small proportion of the Earth's water, but they are extremely important habitats for many kinds of animals. At their source, usually in the mountains, rivers are fast-flowing, and plants cannot root themselves in the river bed. The main source of food for invertebrates, such as water-living snails, leeches and fly larvae, is decaying plant material. This is washed downstream from vegetation that overhangs the river, and is filtered from the water by the invertebrates as they cling to the rocky river bed. Birds and strong-swimming fish then feed on the invertebrates.

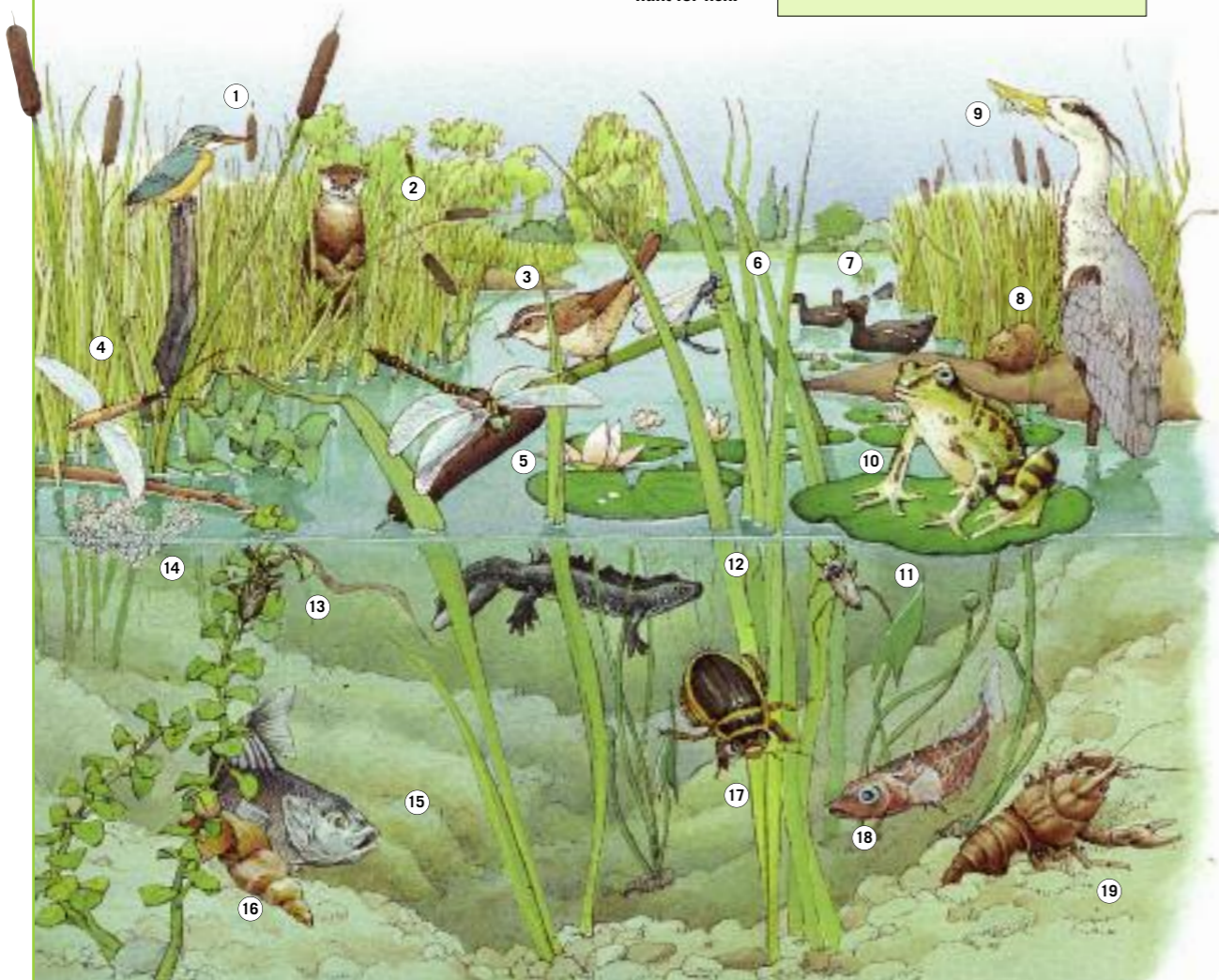
Further downstream, as the gradient lessens, a river is slower-moving. The mud

and silt that collect on the river bottom form a bed for plants to take root. Worms and snails burrow into the mud, while insects and their larvae feed on the plants and the algae that grow on them. They in turn become prey for fish and frogs. Plants also provide protection from predators for newly-hatched fish, amphibians and insects.

This slow-moving river in Europe (below), is thronged with life. Dragonflies hunt smaller insects above the surface, while herons and otters hunt for fish.

**KEY**

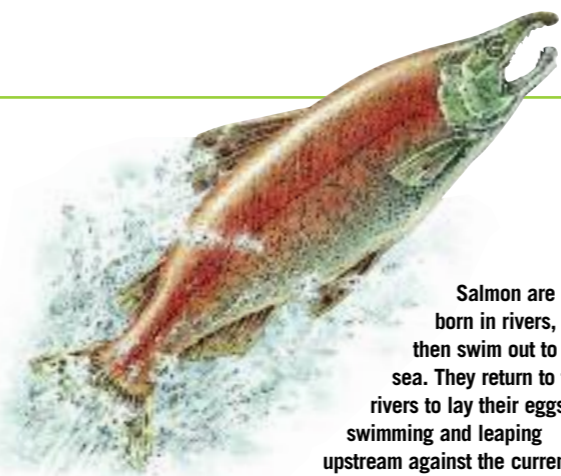
- |                  |                        |
|------------------|------------------------|
| 1 Kingfisher     | 12 Great crested newt  |
| 2 Otter          | 13 Water scorpion      |
| 3 Reed warbler   | 14 Toad spawn          |
| 4 Mayfly         | 15 Perch               |
| 5 Dragonfly      | 16 Pond snail          |
| 6 Damselfly      | 17 Great diving beetle |
| 7 Moorhen        | 18 Stickleback         |
| 8 Water vole     | 19 Crayfish            |
| 9 Heron          |                        |
| 10 Frog          |                        |
| 11 Water boatman |                        |



## PONDS AND LAKES

The still, calm waters of ponds and lakes are an ideal habitat for microscopic floating plants known as algae. They are fed upon by tiny animals, called zooplankton, which are then eaten by insects, snails and small fish.

The great diving beetle lives in ponds. It grabs its prey, even small fish, with its front legs.



Salmon are born in rivers, then swim out to the sea. They return to the rivers to lay their eggs, swimming and leaping upstream against the current.

The many kinds of fish found in slow-moving waters are a vital source of food for large predators. Large fish, such as the pike in Europe, patrol the waters in search of smaller fish to eat. Turtles and swift-moving otters also swim in search of fish. Birds skim insects from the surface, and dive or wade through the water, stabbing with their beaks to make their catch.

The river banks provide shelter for many animals. Small mammals such as voles live in holes above the water line, while birds nest among the tall reeds and rushes that often grow in the shallows.

In small ponds, the major predators are newts and frogs, while fish can be found in larger ponds and lakes. Tall water plants take root in the bottom. They provide insect larvae with a "ladder" out of the water when they emerge to become adults.

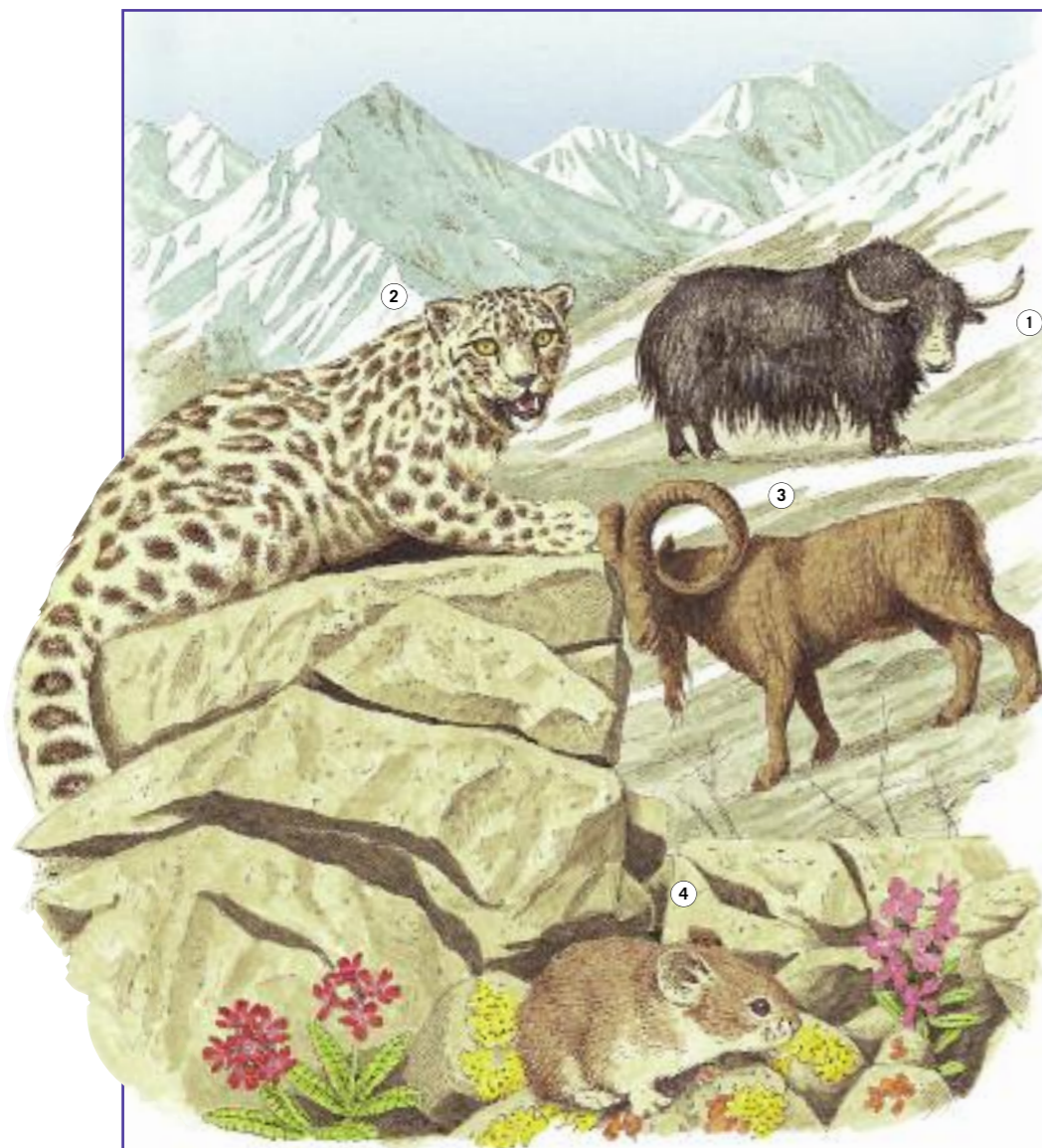
Wetlands are formed at the edges of lakes, where rivers meet the sea, or where the land is flooded. Potentially highly fertile, wetlands are one of our most threatened habitats, as they are often reclaimed for farming or for building land.

The Everglades of Florida, USA (right) is an area of swampland and slow-moving water. Tall reeds dominate the waterlogged land. Wading birds such as flamingoes and spoonbills feed in the shallows, while alligators roam the deeper water.

**KEY**

- |                       |
|-----------------------|
| 1 Everglade kite      |
| 2 Flamingo            |
| 3 Alligator           |
| 4 Spoonbill           |
| 5 Swamp rabbit        |
| 6 Cottonmouth         |
| 7 Raccoon             |
| 8 Tree frog           |
| 9 Tarpon (young fish) |





**KEY**  
 1 Yak  
 2 Snow leopard  
 3 Himalayan ibex  
 4 Pika

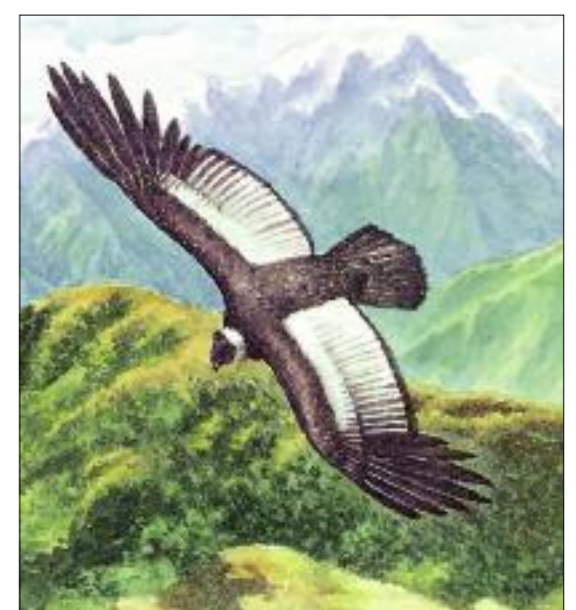
The peaks of the Himalayan mountain range, in southern central Asia, are rocky and snow-covered. The highest ridges are the territory of sure-footed animals such as the Himalayan ibex. The ibex is the favourite prey of the powerful snow leopard, whose white coat camouflages it against the snow. Its coat is thick, and even its paws are covered with fur to keep out the cold. Pikas, small relatives of rabbits, can also fall victim to the snow leopard if they are not agile and fast enough to escape.

The largest animal in the Himalayas, the yak also has thick fur, with another coat of long hair on top. This keeps the yaks so warm that they have to move higher up the mountains to cooler areas in the summer.

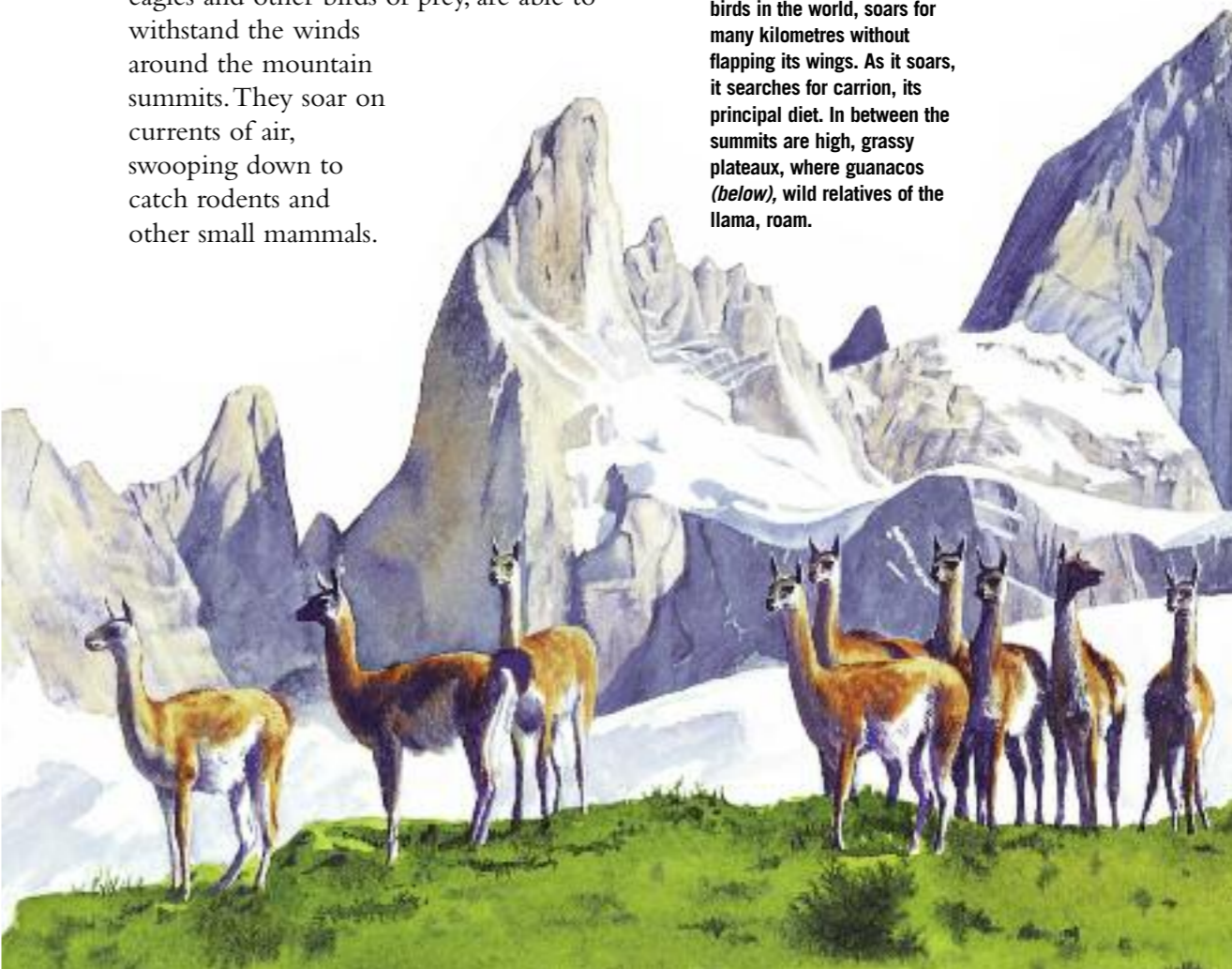
Insects abound on the mountains during the warmer summer months, but many are flightless, as they would be swept away by the strong winds. Even in the snow-covered high peaks, insects and spiders survive. They feed on frozen insects that are blown up from the lowlands by the winds.

Small mammals such as the pika in Asia, or the rock hyrax in Africa, live in burrows or rocky outcrops, to protect themselves from the worst of the cold and wind. Many also hibernate during the winter. Larger animals have thick fur or woolly coats to keep out the cold. Grazing animals, such as sheep and goats, live at the highest altitudes. Their nimble hooves are able to negotiate even the most treacherous slopes. They are preyed upon by wolves, snow leopards and cougars or mountain lions.

Only the strongest-flying birds, such as eagles and other birds of prey, are able to withstand the winds around the mountain summits. They soar on currents of air, swooping down to catch rodents and other small mammals.



High above the Andes mountain range in South America, the Andean condor (*above*), one of the biggest birds in the world, soars for many kilometres without flapping its wings. As it soars, it searches for carrion, its principal diet. In between the summits are high, grassy plateaux, where guanacos (*below*), wild relatives of the llama, roam.



## MOUNTAINS

**T**HE HIGHEST mountaintops are covered with snow all year round. Those that lie in tropical regions, such as Kilimanjaro in Africa, can have hot, steamy rainforest at their foothills and freezing night-time temperatures at their summits. At high altitudes the sunlight is intense. There are strong, cold winds and a lack of oxygen in the air.

Despite these dangers, mountains can host a wide variety of life. Both animals and plants have adapted to live in such harsh conditions. On tropical mountains, some species of plants and animals have developed in isolation. The plants are not able to

spread their seeds far enough to reach another mountain, and even the animals cannot migrate from one mountain to another, because of the inhospitable heat in the lowlands.

On their lower slopes, mountains are often forested, but higher up the trees give way to dry scrubland and rocky, windswept terrain. The flowering plants that grow here are short and strong, and are able to conserve water as much as possible in the drying winds. Close to the summit, only the most hardy kinds of plants, such as lichens and mosses, can grow. With the coming of spring, snow covering much of the mountain may melt and new plants emerge.

## LIVING WITH PEOPLE

ALL ANIMALS share the planet with human beings, many suffering the consequences (see pages 30-31). Some, however, have learned to live in habitats that humans have created, such as towns and cities, or farmland. They have adapted their lifestyles to suit this new environment. Birds use roofs, gutters and chimney pots as roosting and nesting sites, instead of cliffs and trees. Bats gather in warm attics or empty buildings instead of caves and holes.

The warm air given off from houses, offices and factories draws flocks of birds into towns and cities on winter evenings. Many people enjoy seeing birds, and some put out food to help them through the coldest periods. However, birds and people also come into conflict. Flocks of birds are a hazard at airports, where they can be sucked into aircraft engines, causing damage.

The vast quantities of rubbish produced in a town or city also attracts less welcome animals. Rats, foxes, gulls, vultures and even larger animals such as jackals, baboons or

The feral pigeon (right), so familiar in many major towns and cities, is descended from escaped domestic pigeons. These in turn evolved from the rock dove. Pigeons roost on rooftops, and have adapted their diet to include scraps and pieces of bread thrown to them by people.

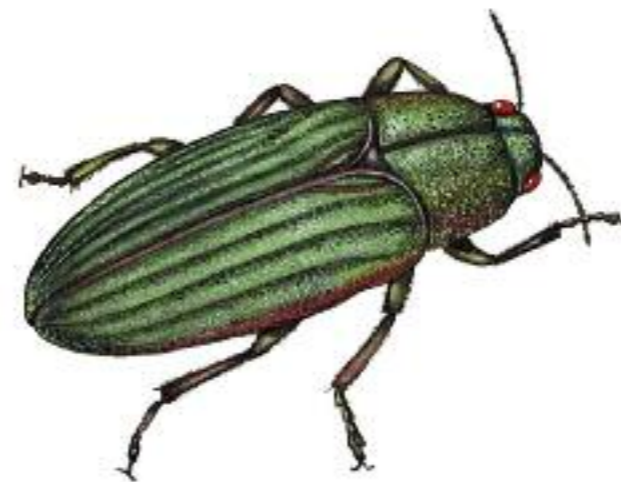


polar bears, all scavenge from rubbish dumps in various parts of the world. Raccoons rummage through dustbins in North America to get at the food inside.

Rats, along with mice, are found wherever people live. These adaptable animals have become pests, eating our food and spreading diseases. Flies, fleas, lice and cockroaches also live close to humans, some also spreading disease, while mosquito bites are a constant danger in tropical countries.

Other insect pests attack crops, or cause damage to homes and other buildings. Buprestid beetles (below) feed on house timbers, while clothes moths make holes in our clothing. However, some insects also have a beneficial effect on our lives. Bees are vital for the pollination of plants—in fact, much of the world's crop yield comes from plants pollinated by wild bees.

Other insects feed on pests which attack crops. Without the right balance of natural pest-controlling agents, however, pests can increase in number and destroy entire crop harvests. The use of chemical pesticides can upset this balance even further, as well as harming other animals.



Humans have often created further problems by introducing species from one country into another. Rats arrived on islands in Oceania with the early European settlers, and became pests. To control them, the settlers brought in cats or mongooses, which quickly destroyed many of the native birds, small reptiles and mammals. Rats, themselves, have killed whole populations of birds on small islands that had previously had no native predators.

Other introduced animals have competed with native species for food and habitat. The grey squirrel, introduced to Britain from the United States, has out-competed the native red squirrel, which is now found only in a few areas. Red deer imported into New Zealand compete with other grazing animals and destroy woodland.

Farming has made a huge impact on the environment, replacing woodland, wetland and grasslands with cropfields and grazing land. Some animals have adapted to take advantage of these new habitats. Rabbits, mice and many kinds of birds feed and nest among the crops and in the hedgerows of agricultural land.



**KEY**  
 1 Raccoon  
 2 Gulls  
 3 Brown rat



## ANIMALS IN DANGER

**A**NIMALS have always experienced rises and falls in their numbers, and many species have become extinct through a long, natural process. Since humans came on to the scene, however, the rate of extinction among species of plants and animals has risen dramatically. Humans have hunted animals to extinction for food or sport, and have driven them from their natural habitats. Some of the best-known animals in the world today, such as the tiger or the rhinoceros, are in danger of extinction. Many lesser-known (but no less important) species are also under threat.



The illegal trade in elephant tusks is a constant battle between poachers and the wardens who protect the elephants.

People have always hunted animals for food, but unlike other predators, humans may pursue a single species ceaselessly until it has become extinct. Many kinds of whale almost became extinct during the 18th and 19th centuries, due to the high rate of hunting for their meat and oil. In a similar persecution, island animals, especially flightless birds that had no natural predators, proved easy targets for the first human settlers. With small populations and nowhere to retreat to, these animals were driven to extinction within a short time.



Once common in many places, barn owls are rare in much of Europe due to loss of habitat—barns and other old buildings to nest in and hedgerows in which to hunt small mammals. Projects are underway to encourage the owls to return.

Animals are also hunted for sport. “Big game” animals such as lions, tigers and elephants were shot as trophies by European hunters during the early 20th century. Today, songbirds in northern Europe are declining in number, due in part to hunting as they migrate across southern Europe.

The trade in animal skins to make fur coats or rugs has drastically reduced the numbers of cats such as ocelots and tigers. Rhinoceroses are killed just for their horns, which are used as medicines in the Far East. Only about 60 Javan rhinoceroses survive in the world today. Elephants are killed for their ivory tusks, which are made into ornaments. Young apes are taken for the pet trade, and the adults in their group killed. Despite restrictions and bans on these kinds of trades, illegal poaching still goes on.



Javan rhinoceros



Tree-felling in the Southeast Asian rainforest has deprived orang-utans of much of their habitat.

Loss of habitat also puts many animals in danger. As more and more of the natural, wild areas of the Earth are cleared to make way for housing, roads, industry or crop and livestock farming, animals become isolated and have nowhere to move to if their habitat is threatened. There may not be enough food to support a population of animals, so they face extinction.

Breeding programmes in the USA have saved the black-footed ferret (below) from extinction.



In the face of these constant threats to wildlife, conservation programmes are fighting to save as many species as possible. Wild plants are being gathered and cultivated, especially rainforest varieties that may have medicinal benefits we do not yet know of. Nature reserves have been set up all over the world, with wardens who guard the animals against poachers. Breeding programmes are carried out among the most endangered animals, to try to increase their numbers. In the most successful of these, animals can be released into the wild.



A relative of the lemurs, the aye-aye (above), feeds on fruit and grubs in the Madagascan rainforest. It is very rare, due to habitat loss and persecution from humans, who think it brings bad luck.



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