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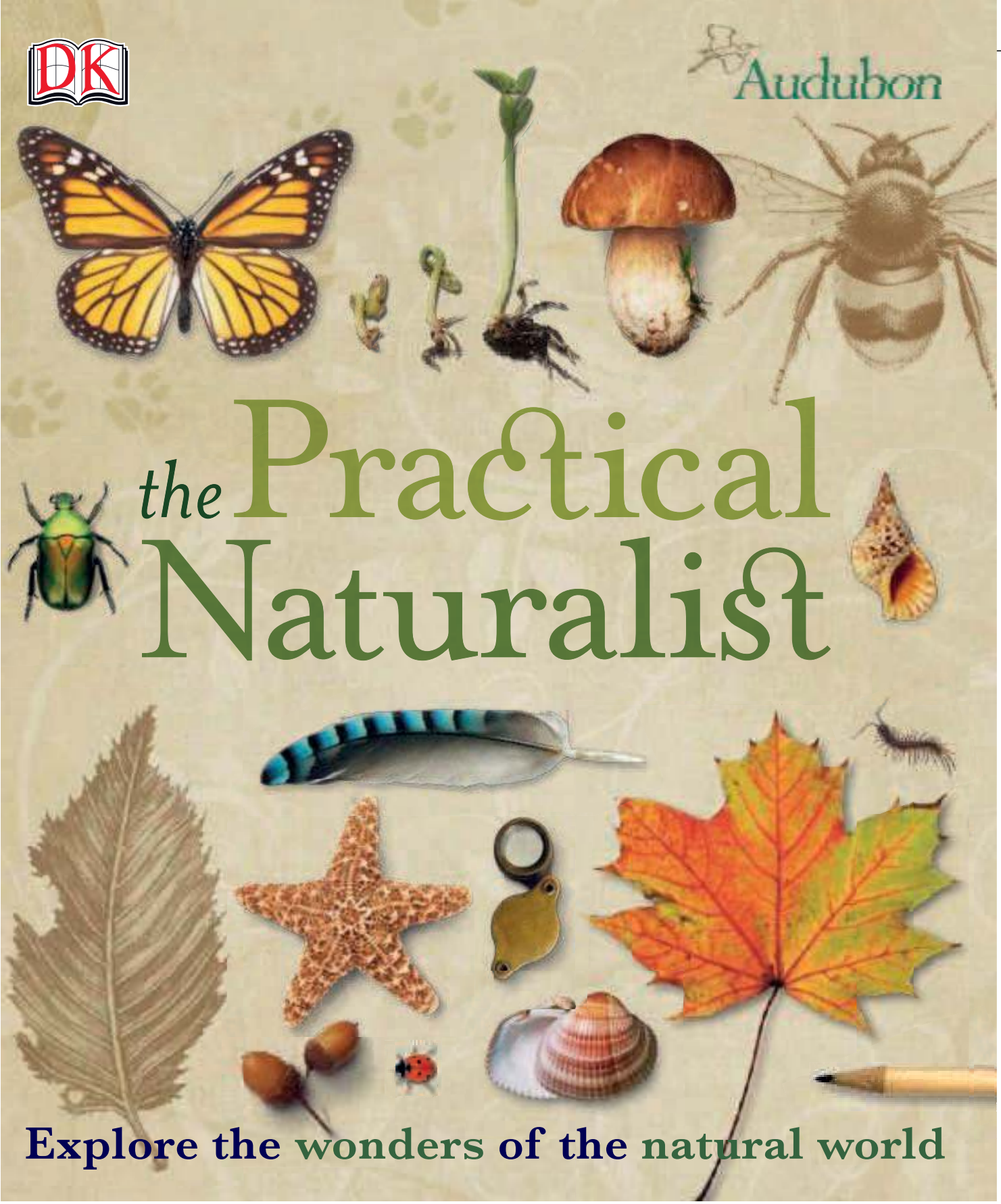
Audubon



the Practical Naturalist

Explore the wonders of the natural world

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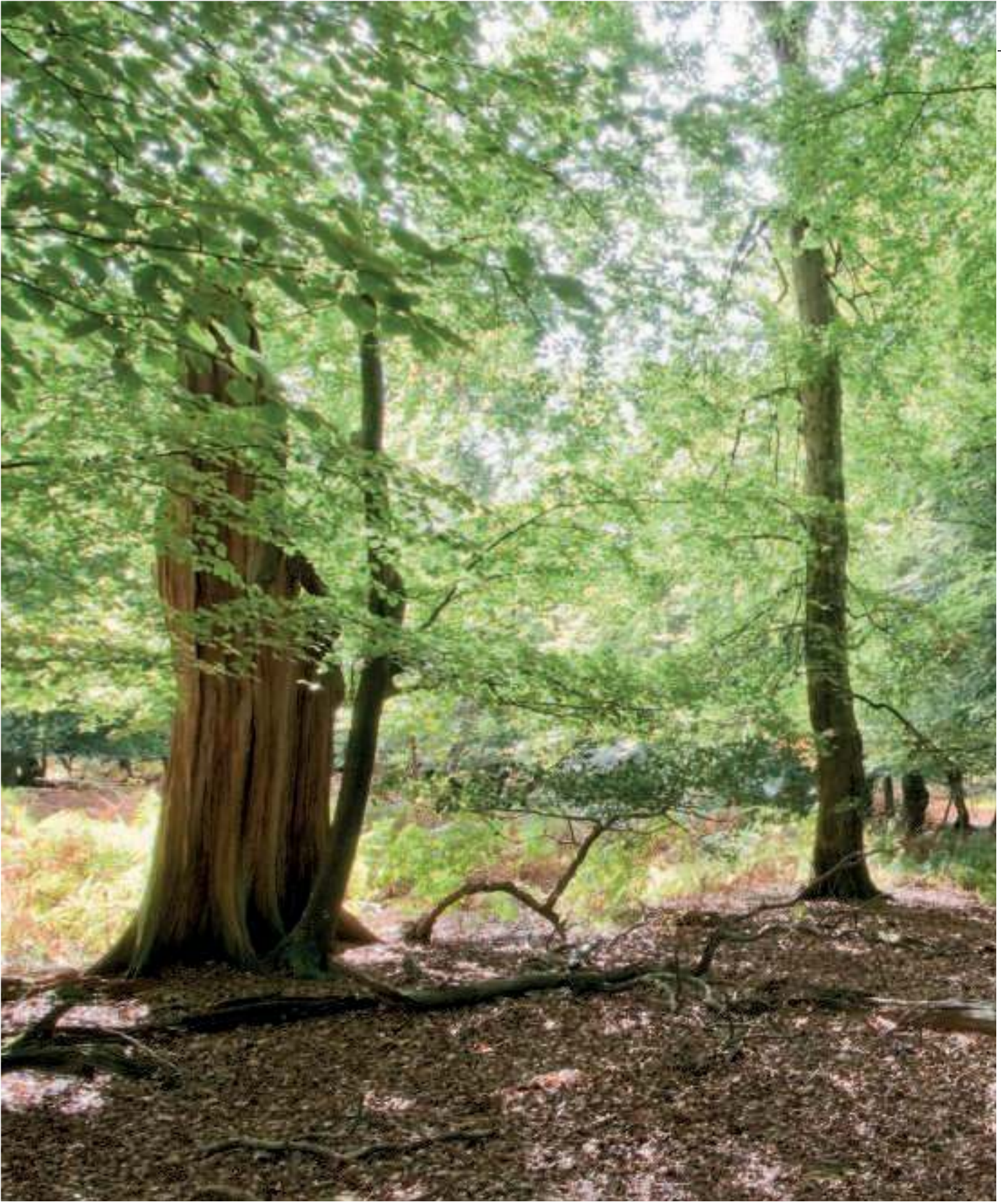

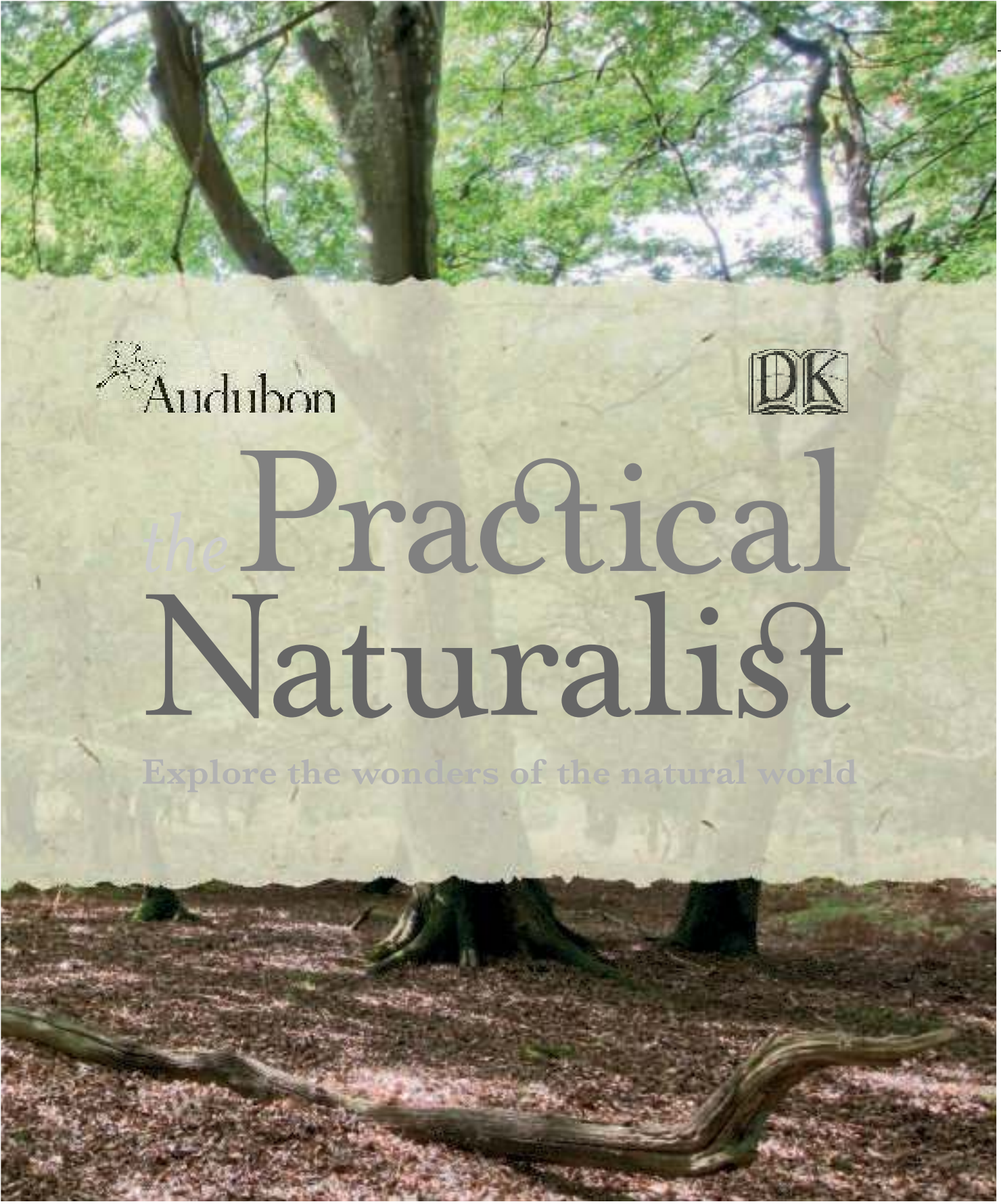
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Explore the wonders of the natural world

LONDON, NEW YORK, MELBOURNE, MUNICH, AND DELHI

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Consultant Editor

Chris Packham developed a fascination with wildlife from an early age and studied zoology at Southampton University, England. He has written several books on wildlife and has hosted many nature-based TV shows for the BBC including, *Springwatch* and *Autumnwatch*. Chris is involved with many wildlife conservation organizations including The Wildlife Trusts, The Wildfowl and Wetlands Trust, The Bat Conservation Trust, and is a Vice-President of the RSPB.

Contributors

Steve Backshall (Mountain and hillside) is a naturalist, author, and television presenter, who has traveled to more than a hundred countries, discovered new species, and climbed some of the world's highest mountains.

David Chandler (Web of life; Lake, river, and stream) is a freelance writer and environmental educator. David's books include the *RSPB Children's Guide to Bird Watching*, *All About Bugs*, and *100 Birds to See Before You Die*.

Chris Gibson (Coast) is a lifelong naturalist who writes, teaches, and broadcasts about the natural world. He is a senior specialist for Natural England.

Robert Henson (Weather) is a meteorologist and science journalist based in Colorado. He has worked as a tornado researcher and written extensively on climate change.

Rob Hume (What a naturalist needs; Forest; Consultant) worked for the RSPB for 30 years, editing *Birds* magazine for 15, and has written around 30 books.

James Parry (Tropical forest; Scrubland and heath; Grassland; Desert) is a writer and lecturer who has traveled widely to study wildlife and different habitats. He has written several books on natural history.

Dr. Katie Parsons (Close to home; Farm and field) has a PhD in animal behavior and ecology. She is currently a freelance conservation consultant and science writer.

Elizabeth White (Tundra and ice) is a documentary film-maker for the BBC Natural History Unit. She has a PhD in animal behavior and has filmed wildlife across the globe, including Antarctic and the high Arctic.

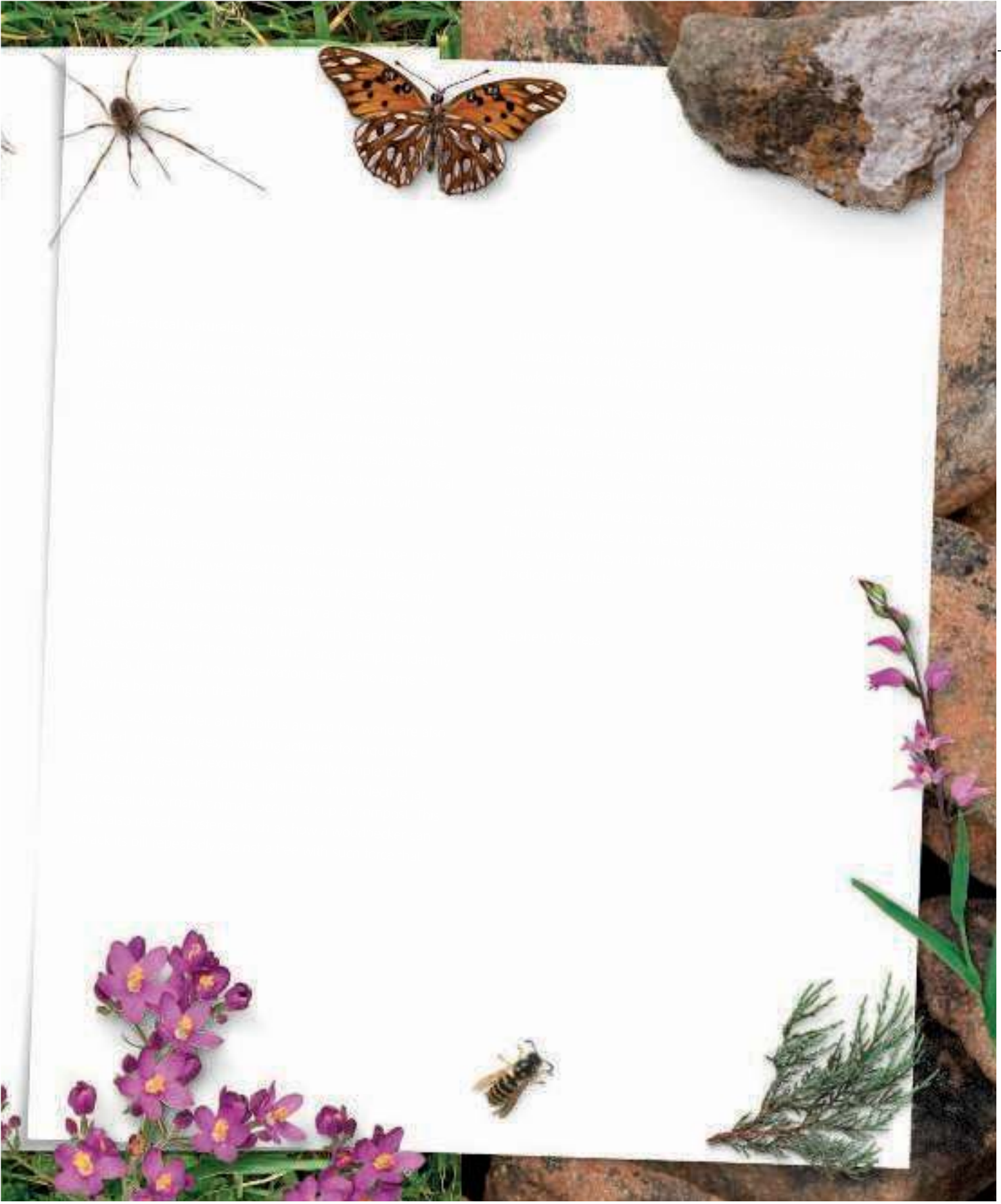
Steve Kress (Consultant) is a staff biologist for the National Audubon Society and a research fellow at Cornell University Laboratory of Ornithology. With Audubon, he started Project Puffin to restore seabirds such as Atlantic puffins and terns to the coast of Maine.

Contents

ABOUT THIS BOOK

This book is intended to be an inspirational guide to exploring, understanding, and observing the natural world wherever you may be. The species included are examples of the type of wildlife that exists in each habitat, wherever they occur in the world. Not all examples shown for a given habitat will be found together or in one specific geographical location.

Foreword



The web of life

The simple beauty of life can be relished on many levels. A single bright-red ladybug on a fingertip is perfect. The fresh scent of a rose is sublime. The tiny rainbows seen flashing from the wings of aphids on the rose's stem are also unexpected gems, and the marvel of a myriad of ants flying up into the summer sky makes an urban spectacle. Each is individually remarkable, but then, so are the relationships that essentially and intrinsically link them all. There is an undeniable and satisfying beauty to be found in an understanding of these webs that knit life together.

The nature of the planet

Much of the time, we are aware only of life immediately around us, yet this is only a small part of a much larger network. Life on Earth exists in many places—some very different to others, but all are connected.

The thin green line

Life in all its forms is found exclusively on the Earth's outermost layers, including the land, oceans, and the atmosphere surrounding the planet. This narrow strip is known as the biosphere—a word that literally means "life ball." Within it are millions of species, of which humans are one, with each dependent on others for their survival. The biosphere isn't uniform, however—it is a collection of different, yet interconnecting habitats, which have many ill-defined boundaries between them.

TUNDRA
Exposed, cold, and treeless, with many lichens and mosses, tundra is a habitat of the far north.

Key

- Grassland
- Desert
- Tropical forest
- Temperate forest
- Coniferous forest
- Mountains
- Polar regions and tundra
- Rivers and wetlands
- Coral reef
- The oceans

WORLD BIOMES DISTRIBUTION
The scientific word for a habitat is a biome. This map shows the variety of these biomes and their distribution, which is determined by climate and geology. Human impact on the environment isn't indicated—areas shown as temperate forest, for example, may now be farmland.

GRASSLAND
Grassland includes savannas, steppes, and prairies. It experiences more rainfall than deserts, but is drier than forests.

REED BEDS IN NORFOLK, UK
Many of these important habitats would be lost today if they were not periodically managed.

HABITAT-MAKER

Left to their own devices, some habitats are transient, changing from time to time. Reed beds are a good example. Often, dead vegetation builds up at the base of the reeds. This dries out the reed bed, allowing other species to gain a foothold. Scrub may take over, and ultimately woodland, which is a much more stable habitat.

AQUATIC
Aquatic habitats include lakes and streams to rivers and oceans. They may be saltwater or freshwater.

More than one home

Some animals have a very strong connection with a single habitat—Europe's bearded tits, for example, are small birds found mainly in reed beds. Other species make themselves at home in many habitats—the adaptable carrion crow can be seen in woods, uplands, and foraging on estuaries, among other places. Dragonflies make a big habitat change when they become adults.

adult winged dragonfly emerging from its larval "skin"

TRANSFORMER
The first part of a dragonfly's life is spent underwater as a larva, yet once it matures, it becomes an aerial predator.

FOREST
Forests are highly varied and species-rich habitats. Types of forest include northern boreal, tropical, and temperate forests.

DESERT
Deserts seem barren, experiencing almost no rain and possessing little or no vegetation. However, many species have adapted to desert life.

LIFE ON EARTH

All life on Earth exists as part of an intricate web of interconnections. These images help to put some of these into context. They start with an individual of one species, and, step by step, move on to the biosphere. Individuals of any species don't generally live in isolation—others of their kind normally reside in the same area. Together, these make up a population. Add populations of other species in the same area and this builds into a community. The community lives in a specific habitat, with a certain climate, geology, and soil—together these living and non-living components make up an ecosystem. Put all the ecosystems together and you have the biosphere. In this way life on earth is interconnected, and we should take care to not tip the balance.

INDIVIDUAL
As a naturalist, you might encounter just one individual of a species. However, it is part of a larger group.

POPULATION
The individuals of a species in one area make up the population. Different species have different sized populations.

COMMUNITY
All the populations together form a community, where population fluctuations for one species have an impact on species.

ECOSYSTEM
Ecosystems may be large or small, and combine living components with an area's physical characteristics.

BIOSHPERE
This is the "ball of life." It is made up of all individuals in every population in every community and all habitats on the planet. The true worldwide web.

The diversity of life

The diversity of life on Earth is extraordinary. As a naturalist, there is always something new to understand, experience, and enjoy.

Scientists have identified about 1.8 million species, and it is estimated that as many as 6 to 12 million more are waiting to be discovered. Humans are just one animal species among many, but we have a unique role to play in understanding and conserving the rest.

Evolution

Just as human families exhibit variations in, for example, eye color, animals vary within a species. As differences are passed on to subsequent generations, they slowly change, or evolve, into creatures with varied appearances and capabilities. Suppose one bird has a larger bill than its neighbor and is better at feeding its young so that more of them survive. Some of its chicks also have larger bills, and, with time, more offspring acquire larger bills until they look quite different from their smaller-billed relatives. If there comes a time when the large bills can no longer breed successfully with the small bills, a second species has been created.

SLOW PROGRESSION
The elephants we recognize today are believed to have evolved from a prehistoric animal called *moeritherium*—an animal that more closely resembled modern tapirs.

MAMMALS
Mammals make up
known species, inclu
raccoons, tiny bats,
camels, kangaroos,
cheetahs, giraffes—a

BIRDS
The 10,000 known b
are widely diverse, ra
ostriches to penguins
eagles, ducks and sta
hummingbirds, and

REPTILES
These are cold-blood
and their bodies are
in scales. There are c
known species, inclu
snakes, turtles, and c

AMPHIBIANS
These animals have a
both in water and on
about 5,000 species
including caecilians, s
and newts, and frogs

EVOLUTION IN ACTION

The five digits in this skeletal paw, and what looks like a thumb, belong to the giant panda, a member of the bear family. The "thumb" is actually a wrist bone, but it is much larger than that of, say, a brown bear. It can also move, is padded, and works with the true digits to make it easier for the panda to handle bamboo, its preferred food. This appendage may have evolved over thousands of years as a trait that was beneficial to the panda's survival.

Amazing adaptations

Evolution is about change, and if an inherited characteristic increases the chance of survival by making an animal better at finding food or avoiding predation, for example, then those attributes are more likely to be passed on to the next generation. Within the animal kingdom, some species have—over many generations—evolved an array of adaptations to meet the challenges of life, including capabilities such as camouflage or super-sharp senses, a bill that functions as a specialized feeding tool, antifreeze in the blood, or even feathers that hold water.

MIMICRY
Predators may keep their distance from some nonvenomous species of milk snake, which have evolved to resemble highly venomous coral snakes.

CORAL SNAKE

MILK SNAKE

PERFECTLY ADAPTED
Sword-billed hummingbirds use ultra-long bills to reach nectar in flowers, pollinating them in the process.

FISH
Earth's brackish, fresh
are home to almost
fish species, including

INSECTS
Around 950,000 inse
share the planet with
500,000 of them are
dragonflies to bees, c
butterflies, the forms

FLOWERING PLANT
Around 260,000 flo
species have been r
land and in water. Th
grasses, trees, and m
blooms, such as the

TREES
The definition of wha
considered a tree is
but there are an estim
100,000 tree specie

FUNGI
There are around 10
species of fungi. Toa
mushrooms belong t

Animal life

Animals occupy particular niches within the complex web of life, and have evolved various strategies and behaviors to ensure survival.

SCAVENGER

Herbivores, carnivores, and scavengers

Simply put, green plants use the Sun's energy to grow, herbivores eat the plants, and carnivores eat herbivores. But feeding relationships are often more complex. Carnivorous foxes prey on herbivorous rabbits, but also eat fruit. Crows may scavenge from the dead bodies of both animals, but also eat seeds, fruit, insects, and small animals. They are taking advantage of evolutionary niches by developing different eating habits.

HERBIVORE

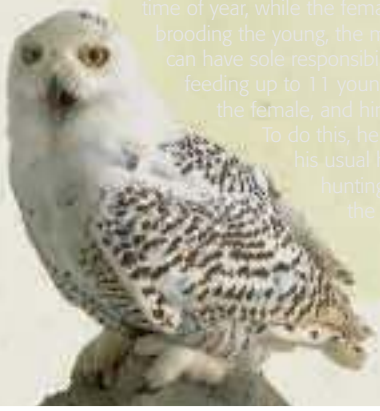
CARNIVORE

Early bird or night owl?

Not all animals are active at the same time, which can reduce competition between species; for example, butterflies take nectar from flowers during the day, while most moths do so at night. Animals that are active during the day, such as most lizards, are "diurnal" and those that are active at night, such as hedgehogs, are "nocturnal" (see pp.54–55). Some animals are "crepuscular," which means you are most likely to see them at dusk and dawn.

FLEXTIME

The snowy owl is a crepuscular hunter that raises its young on the Arctic tundra, where, in the very far north, there is no darkness for months during the summer. At this time of year, while the female is brooding the young, the male can have sole responsibility for feeding up to 11 youngsters, the female, and himself. To do this, he adapts his usual habits, hunting in the day.



NIGHT AND DAY
Hedgehogs are nocturnal mammals found in Europe, Africa, and Asia. Lizards can be diurnal or nocturnal—this viviparous lizard is diurnal.

DIURNAL

NOCTURNAL

SLEEPY BUGS
Some ladybugs hibernate in groups, using fat deposits to help them survive the winter. One such gathering was found to contain over 10,000 individuals.

Getting away from it all

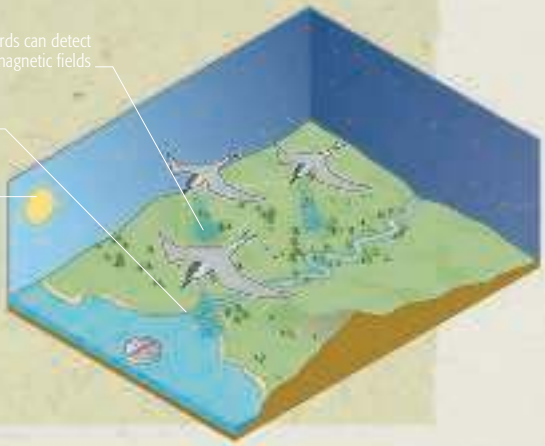
Mammals need to eat to stay warm, but in winter food can be hard to find. Some survive by hibernating. During this time their metabolisms are turned down to a minimum, and they use the fat deposits they laid down while food was plentiful to fuel this low-energy winter existence. There are also invertebrates, reptiles, and amphibians that hibernate. Migration is a strategy that is employed most visibly by some birds, but also by fish, butterflies, moths, and land and sea mammals. These creatures travel huge distances, often along well-defined routes, in search of food and breeding grounds.

LAND MIGRATION
Migrating caribou can travel over 3,100 miles (5,000 km) a year, crossing water if necessary. No other land mammal covers such a distance.

EPIC JOURNEY
Humpback whales migrate farther than any other mammal. Their journey, between the Central American Pacific and the Antarctic, is over 5,000 miles (8,000 km).

HOW MIGRATING BIRDS NAVIGATE

A bird's ability to navigate between breeding grounds and wintering areas, which can be thousands of miles apart, is staggering. Visual clues assist them, for example a river may keep them on track, and the Sun acts as a compass, with birds using their "internal clock" to compensate for its apparent movement. At night they use the stars as a guide. Birds can also detect the Earth's magnetic fields and use these to navigate. As they get closer to their destination smell may help: petrels, for example, find their burrows by smell.



MENTAL MAP
True navigation relies on a mental map to find a destination. Some young birds follow adults on their first migration, but other species are born with the information they need and make the trip alone.

Back from the brink

Human intervention in the natural world can have a dramatic impact on the lives of animals and plants.

Humans can have a detrimental effect on animal and plant populations through a variety of means. However, we also have the capacity to turn things around, and in some cases this has happened. The sea otter is one such example. Once hunted to near extinction for their fur, now, thanks to successful conservation initiatives, they can again be seen in waters off North America's Pacific coast. Conservation projects have also helped the American bison, after hunting had decimated herds that once totalled many millions, and the osprey, which, by 1916, had been persecuted to oblivion in the UK by egg collectors and hunters. Similarly, the large blue butterfly had disappeared from the UK by 1979, but has been successfully reintroduced. Although successes like these can be achieved, many species of plants and animals remain threatened.

OSPREY
Ospreys returned to Scotland in 1954. Around-the-clock protection and recent reintroduction to England has helped UK numbers rise to around 150 pairs.

AMERICAN BISON
The American bison has been brought back from the brink of extinction. Over 150,000 now live on ranches and reserves.

LARGE BLUE BUTTERFLY
Reintroduction and appropriate land management has helped save the UK's large blue population from extinction.

SEA OTTER
Reintroduction projects and legal protection have enabled populations of sea otters in the North Pacific Ocean to reach over 100,000 individuals.

Weather and sky

Perhaps no greater factor has a more important or powerful influence on all life than the weather—from the very short to the very long term. Hourly, daily, or seasonal variations exert profound effects on species and their populations, and individual events can provoke catastrophe or celebration. A cloudburst in the desert, for example, is the source of an explosion of life, but the same event could extinguish it elsewhere. The impact upon our species seems set to become ever more critical as we pitch our predictive abilities against increasingly turbulent fluctuations in the world's atmospheric conditions. Thus, understanding weather is fundamental to understanding all life on Earth.

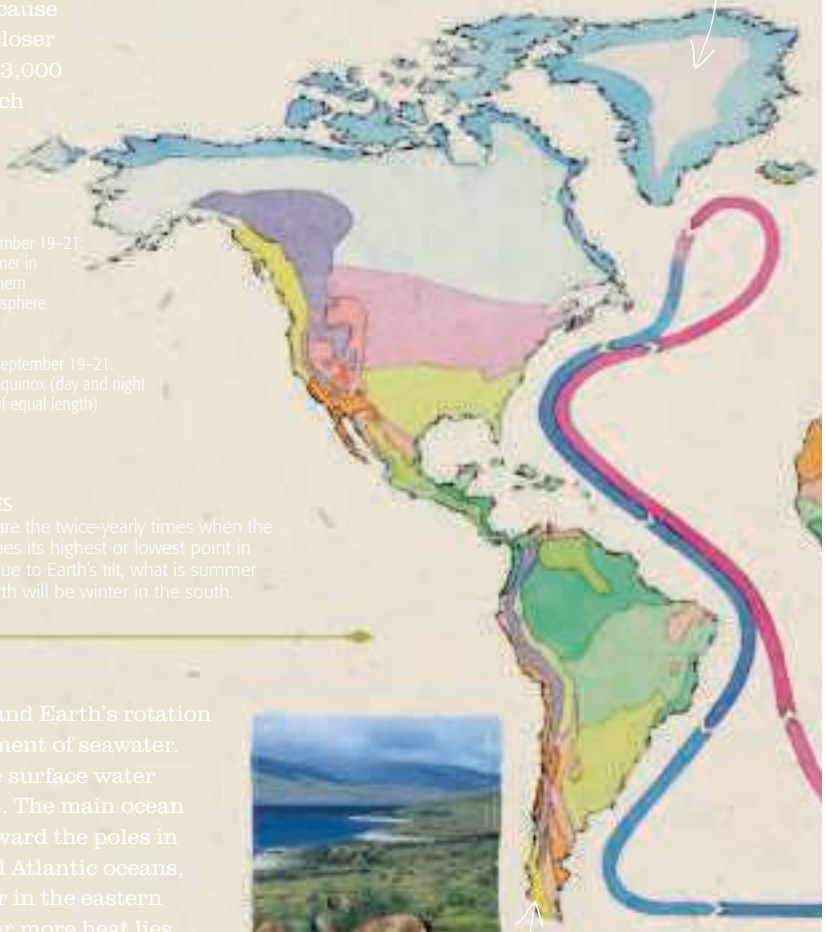
Climate and seasons

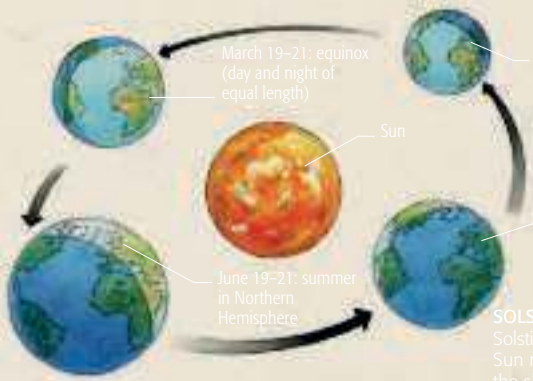
You can see variations of weather in daily and seasonal cycles and regional patterns. Together, these produce a climate: the norms and extremes that occur at a given place.

The Sun

Without solar energy there would be no climates on Earth. Daily cycles of sunshine and darkness result from the planet's rotation, and seasons are caused by the tilt of Earth's axis as it orbits the Sun. Because this orbit is not absolutely circular, Earth is closer to the Sun in January than in July. In about 13,000 years, however, the opposite will be true, which should warm northern summers.

POLAR CLIMATE
Some bird and whale species migrate to the polar regions, as regional sea ice expands and retreats seasonally.





SOLSTICES
Solstices are the twice-yearly times when the Sun reaches its highest or lowest point in the sky. Due to Earth's tilt, what is summer in the north will be winter in the south.

JET STREAMS
These fast-moving air currents help regulate the climate by connecting areas of contrasting temperatures and air pressure.

Currents

Continents, sunlight, and Earth's rotation all influence the movement of seawater. Trade winds help drive surface water west across the tropics. The main ocean currents then move toward the poles in the western Pacific and Atlantic oceans, and toward the equator in the eastern Pacific and Atlantic. Far more heat lies in Earth's vast, dense oceans than in its relatively thin atmosphere. It is this marine influence that helps keep northerly London fairly mild, and equatorial Lima, Peru, surprisingly cool. Meanwhile, a broad "conveyor belt" threads through the global oceans (see map, above right).

OCEAN WARMTH
Despite being near Antarctica, southern Chile is insulated from extreme cold by the surrounding ocean, making it habitable for temperate-zone species.

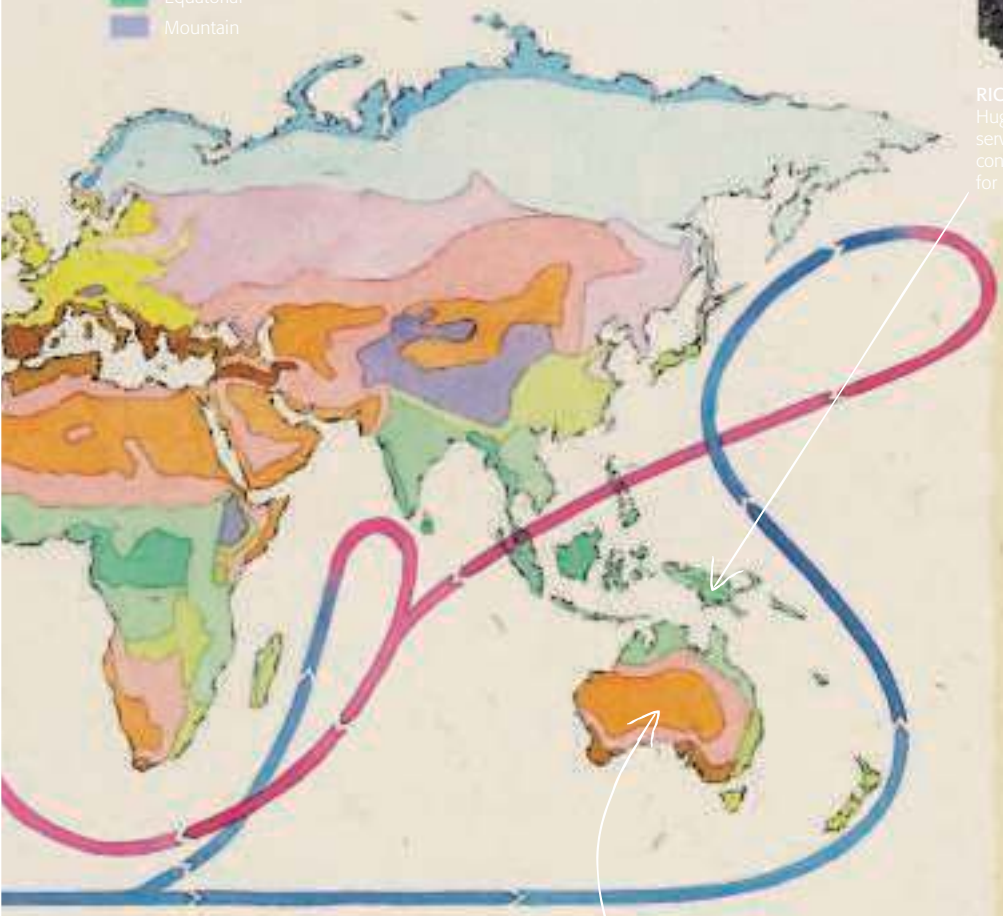
KEY

- Polar
- Tundra
- Subarctic
- Continental
- Temperate
- Warm, oceanic
- Mediterranean
- Semiarid
- Arid
- Subtropical
- Equatorial
- Mountain

Global zones

All habitats and biomes (see pp.10–11) are affected by climatic factors such as sunlight and moisture. The Earth is grouped into a system of climate zones (see below), with latitude, the distance from the equator, by far the strongest influence. Ocean currents and surface types are also important. Coastal deserts get little or no rain, thanks to cool offshore waters and stable air, yet thunderstorms rage across temperate zones, where heat builds more easily and air masses often clash.

RICH DIVERSITY
Huge tree canopies in tropical rainforests serve as sunscreens, keeping the air constantly warm and moist, which is ideal for animals such butterflies and frogs.



KEY

- WARM SURFACE CURRENT
- COLD, SALTY, DEEPWATER CURRENT

CONVEYOR BELT
Warm surface water flows from the tropical Pacific and Indian oceans around Africa, then north across the Atlantic. The water gradually sinks, forms cold bottom water, then completes the loop.

ARID CLIMATE
Despite dry conditions and large daily swings in temperature, many creatures and plants, such as lizards and spinifex grass, are well adapted to deserts.

CORIOLIS EFFECT

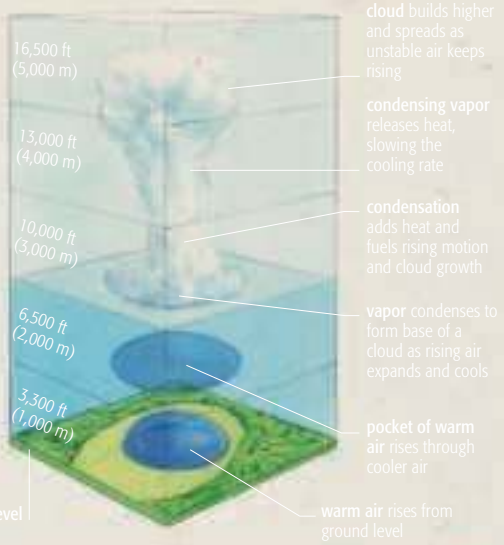
As the planet revolves, it turns more quickly west to east in the tropics (its widest part) than in polar regions. When air currents flow from the tropics to the poles, the speed forces them to bend right over the planet's surface—a phenomenon known as the Coriolis effect. Air moving toward the equator also turns right, creating trade winds (see opposite). This effect helps explain the direction of prevailing winds and the presence of gyres.

Cloud spotting

Learning to read the sky's dazzling variety of clouds is useful for understanding air currents and can help you forecast upcoming weather.

How a cloud is formed

Water vapor is at the heart of every cloud. As warm air is forced upward, it cools, and the relative humidity increases. The rising air becomes saturated, and the water vapor collects around dust, salt, or other airborne particles to form a cloud. The type of cloud is dictated by its temperature, moisture content, and the air flow surrounding it.

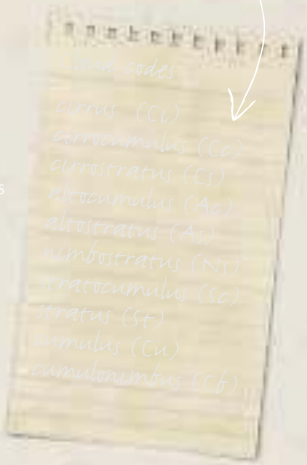


CLOUD FORMATION
As water condenses in rising air, it releases heat. The heat warms the air mass, and causes it to rise farther until it reaches the same temperature as the air surrounding it.

Identifying clouds

The higher the cloud, the lower its temperature. Some are made of ice crystals, others of water droplets, and the composition gives each a different form. Our classification of clouds is based on one created by English pharmacist Luke Howard. In 1783, intrigued by the vivid sunsets created by volcanic eruptions, he developed a cloud-naming system, presenting it to scientists in 1802. Howard divided clouds into four types: stratus (meaning "layer"), cumulus ("heap"), nimbus ("rain"), and cirrus ("curly").

CLOUD LEVELS
Many clouds are combinations of the main categories, so that nimbostratus, for example, is a layer of rain cloud.



SPOTTING SPECIAL CLOUDS

Some types of clouds appear rarely and only in certain areas. Noctilucent (night-shining) clouds form at heights of around 50 miles (80 km). Once observed only at high latitudes (in the north or south), noctilucent clouds are now reported closer to the equator. Sometimes resembling a stack of dinner plates, lenticular clouds develop when a particular arrangement of wind layers passes over a mountain peak or range.

NOCTILUCENT CLOUD
Earth's highest cloud is most likely to be seen just after sunset or before sunrise in summer.

LENTICULAR CLOUD
With such an otherworldly appearance, lenticular clouds may be mistaken for unidentified flying objects.