Fresh water

Every year, about 100,000 cubic km (24,000 cubic miles) of water evaporates from the world's oceans, condenses, and then falls as rain or snow. Most of this water disappears back into the atmosphere to continue this cycle, but about a third returns to the oceans by flowing either over ground or beneath the land surface. This steady supply of fresh water sustains all the world's land-based life, as well as creating highly diverse habitats – from streams, rivers, and lakes, to reedbeds, marshes, and swamps – in which a wide range of different animal and plant life can thrive.

HERONS HUNT *by stealth, waiting along river banks and lake shores for fish to come within range.*

DRAGONFLIES, *like many other insects, spend the early part of their lives in fresh water, leaving it only when they are ready to breed.*

FROGS *vary in their affinity for water. The American bullfrog rarely leaves it, even as an adult.*

MANY AMPHIBIANS, *such as the great crested newt, use still or slow-flowing water containing plenty of plants as a repository for their eggs.*

SMALL CRUSTACEANS *are part of the animal plankton living at all levels in ponds, and at the surface in lakes.*

PIKE *are sit-and-wait predators, using dense waterside vegetation as cover from which to ambush their prey.*

IN GEOLOGICAL TERMS, *lakes and rivers are highly changeable. Lakes gradually fill with sediment, while rivers often change course.*

Lakes and rivers

For permanent water dwellers, life in lakes and rivers is shaped by many different factors. One of these is the water's chemical make-up, which is often dictated by the type of rock that forms the bed of a river or lake. Hard water, for example, is good for animals that grow shells because it contains calcium that can be used as shell-building material, while water that is especially rich in oxygen is important for highly active predatory fish, such as salmon and trout. Water that is very deficient in oxygen, on the other hand, provides a poor environment for animal life as a whole because relatively few aquatic species, apart from specialized worms, can survive in it.

In lakes and rivers, aquatic animals usually occupy clearly defined zones. The brightly lit water close to the surface often teems with water-fleas, copepods, and other microscopic forms of animal life. They live here in order to feed on phytoplankton – the microscopic algae that become extremely abundant during the summer months. Feeding in the middle zone and near the water's surface are larger animals, such as fish, that are able to hold their own against the strength of the current. Weak swimmers live near the banks, where the current is slower, or among stones and sediment on the bottom. In still and slow-flowing water, surface tension supports insects that hunt by walking or running over the water.

Some animals that are associated with freshwater habitats are not necessarily permanent water dwellers; instead they divide their time between water and the adjacent land, entering the lake or river to hunt or breed, or using it as a nursery for their young.

FISH EAGLES *use their long talons to snatch fish from the surface of the water.*

THE JACANA, *or lily-trotter, has long toes that spread the bird's weight so that it can stand on floating leaves.*

THE CAPYBARA, *the world's largest rodent, feeds on land, but uses water as a refuge from attack by predators.*

CAIMANS, *and many other crocodilians, can survive for many weeks when wetlands dry out by wallowing in moist mud.*

THE SNAKE-NECKED *turtle's slow metabolism enables it to remain underwater for long periods.*

LUNGFISH *survive times of drought by lying dormant in mud, protected by their waterproof cocoons.*

Wetland

A wetland is any waterlogged or flooded area with a covering of water plants. In some wetlands – reedbeds and bogs, for example – the plants hide the water completely. However, in most wetland, areas of open water and dense vegetation are mixed, creating a rich and complex habitat that can be exploited by animals of almost every kind.

Biologically, wetland is among the most productive inland habitats, sometimes surpassing even rainforest in the amount of food that it generates for animals. In temperate parts of the world, this productivity reaches a peak during spring and summer, but in the tropics and subtropics it is more affected by the water supply. Some tropical wetlands – South America's Pantanal, for example – largely dry out during the dry season, but then look like vast lakes once it has rained.

In many wetlands, the water is no more than a metre (3¼ ft) or so deep, which means that bottom-living animals and surface dwellers are rarely far apart. This kind of environment is ideal for air-breathing swimmers, such as snakes and turtles, and also for land-based animals that use water as a temporary refuge from danger. Unlike large lakes, wetlands have an extra dimension in the form of emergent plants, which grow up through the water's surface and into the air. These plants range in size from small grasses and rushes just tall enough to keep insects clear of the water, to water-loving trees that grow to over 35 m (115 ft) high. Trees act as important roosting and breeding sites for waterbirds, providing them with shelter and relative safety from predators as well as keeping them close to the source of their food.

FRESHWATER WETLANDS *include the Pantanal, South America, and the Okavango, an inland delta in southern Africa.*

POLLUTION AND ABSTRACTION

Freshwater habitats are affected by human activities in many ways. Water pollution is a general problem that has profound consequences for a wide range of animal life. However, in addition, large areas of wetland have been drained for agricultural use, often because wetland conditions produce highly fertile soil. Water abstraction, both for agriculture and for domestic use, is also an increasing threat to freshwater habitats. Efforts to protect wetlands have produced several international agreements. One of these, the Ramsar Convention, adopted in 1971, focuses on wetlands used by migrating waterfowl.

HIGH AND DRY *In central Asia, the Aral Sea – a giant inland lake – has shrunk dramatically because incoming river water has been diverted to irrigate fields.*

MAMMALS

Primates

PHYLUM Chordata
CLASS Mammalia
ORDER Primates
FAMILIES 15
SPECIES 352

Members of the order Primates – prosimians, monkeys, and apes (but see the Classification note, left) – are a diverse group that form highly complex social units. They are found in South and Central America, Africa and Madagascar, and Southeast and eastern Asia. Primates mostly inhabit tropical rainforests, and their dextrous prehensile (grasping) hands and feet are an adaptation to a largely arboreal lifestyle (some also have a prehensile tail). Traditionally, authorities on primates have recognized about 180–200 species. However, in recent years there has been a thorough reconsideration of primate species, partly because of the need to identify significant populations for conservation purposes. As a result, many new species have been described since 1990.

CLASSIFICATION NOTE

Recent research suggests that primates may comprise 2 suborders: Strepsirhini (lemurs, galagos, lorises, and pottos) and Haplorhini (tarsiers, apes, and monkeys). Tarsiers have features linking them with both suborders; in this book, they are grouped with Strepsirhini (traditionally known as the prosimians). To allow adequate coverage, monkeys and apes are presented here as separate groups. Humans do not appear in this book but are classified, with the apes, as hominids.

Prosimians see pp.136–9
Monkeys see pp.140–9
Apes see pp.150–5

Anatomy

Primates form a highly varied group, with members as diverse as mouse lemurs, which may weigh only 35 g (1¼ oz), and gorillas, which can reach over 200 kg (440 lb). Most species have flat nails on the fingers and toes – only a few have claws – and the big toe always has a nail. Most have a tail, except the apes. Apart from some toothed whale species, the higher primates have the largest brain relative to body size of all the mammals, which helps explain their high intelligence. The cerebral hemispheres (which process sensory information and coordinate responses) are highly developed, allowing sight keen enough for accurate tree-to-tree leaps.

SKULL STRUCTURE
Primates have a large, domed braincase and forward-facing eye sockets. This monkey skull also shows the flattened facial profile that is characteristic of most monkeys and apes.

HANDS AND FEET
Hand and foot structure varies according to lifestyle. Claws (eye-eye) and rounded pads (tarsier) improve grip in arboreal species; highly mobile hands and feet (chimpanzee) are vital for species that live on the ground and in trees.

Social organization

Only orangutans and a few of the lemurs and galagos lead solitary lives; all other primates exist in social groups. Many species – including most monkeys – live in troops that consist of several females and either one or several adult males. In some species, such as the mandrill, drill, and gelada, huge troops of several hundred individuals periodically split into subgroups of bachelor bands and one male and his harem, both of fixed composition. Chimpanzees and spider monkeys live in large communities of 20–100 individuals that divide into groups of varying composition. Some species, mostly New World monkeys, live in monogamous pairs.

MUTUAL GROOMING
The bonds between members of primate groups are partly maintained by mutual grooming, as shown by these olive baboons. Low-ranking members groom those of higher rank to gain favour and support (in disputes).

Feeding

As a general rule, small primates tend to eat insects, whereas larger species mostly eat leaves and fruits (a large primate cannot sustain itself on insects alone). Small primates have a high metabolic rate and cannot afford the long digestion times needed to process vegetable matter. Some leaf-eating species, such as colobus monkeys and langurs, have a complex stomach containing bacteria to ferment cellulose; other primate species have bacteria in the caecum or in the colon. A few species, including chimpanzees and baboons, hunt vertebrate prey as well as eating vegetable matter. Only tarsiers are entirely carnivorous.

EATING VEGETATION
Of all primates, gorillas probably eat the most plant material. In order to break down cellulose (thereby releasing the cell nutrients), gorillas have large molar teeth and strong jaw muscles for chewing. Their pot belly houses a long digestive tract.

EATING MEAT
Given the opportunity, some primates will hunt (sometimes cooperatively) and kill other animals. This common chimpanzee is eating part of a duiker.

CONSERVATION

Primate numbers are declining severely in the wild due to habitat loss and, more recently, through the illegal hunting of protected species (such as the gorilla) for meat. As a result, many species are now endangered. Primates are also widely used in medical and space research. Although a few species are being re-introduced to the wild from zoos with captive breeding programmes, and sanctuaries, such as this chimpanzee orphanage in Zambia (below), provide some refuge, the situation remains bleak.

LIFE IN THE TREES
These black langurs are typical primates in that they are arboreal, have prehensile hands and feet, live in groups, and eat leaves and fruits. Their colourful markings help provide camouflage. Like almost all primates, loss of habitat is a major threat to their survival.

Movement

Most primates spend at least part of their life in trees and have adapted accordingly. To provide a strong hold on branches, the big toe is separated from the other toes in all species except humans, and the thumb is always separated from the fingers, although it is fully opposable (that is, it can turn, face, and touch the other digits in the same hand) only in apes and in some Old World monkeys. The arm and wrist bones are not fused, which increases dexterity. Primates also have "free" limbs – the upper part of each limb is outside the body wall, which allows great freedom of movement. (In other mammals, such as horses, the upper part is inside the body wall – the "armpit" is in fact the elbow joint, which means movement is more restricted.) Some species have a long, prehensile tail, used as a "fifth limb".

SWINGING
Spider monkeys and gibbons, such as this lar gibbon, use their long arms to swing from branch to branch. This is called brachiation.

STANDING
Primates, such as chimpanzees, that are capable of standing and walking on two legs (known as bipedalism), tend to have long legs.

CLIMBING
The most common way of moving is on all fours. Quadrupeds, such as this woolly spider monkey, usually have limbs of about the same length.

CLINGING
Vertical clingers and leapers, such as these indri, move with the back held vertically. They have well-developed back limbs for long leaps between trees.

USING A SIMPLE TOOL

1 **SEEKING TERMITES**
This common chimpanzee has made a stick tool to obtain food that would otherwise be inaccessible.

2 **DEXTROUS HANDS**
The chimpanzee uses its grasping hands to hold and insert the stick into the termite mound.

3 **REMOVING THE TOOL**
The termites on guard, provoked by the intrusion, bite the stick with their pincer-like jaws.

4 **SUCCESSFUL ENDEAVOUR**
As the chimpanzee removes the stick, the termites remain firmly attached.

5 **BALANCING ACT**
The chimpanzee stabilizes the termite-covered stick by resting it on the opposite forearm.

6 **EATING QUICKLY**
Most of the termites are swiftly gobbled before they can escape, including any on the forearm.

7 **MORE OF THE SAME**
Once all the termites have either been eaten or escaped, the chimpanzee will repeat the process.

8 **LEARNED BEHAVIOUR**
Making and using tools is rare in mammals. Juvenile chimpanzees acquire these skills by copying adults.

MAMMALS

YOUNG LIFE

A young tiger is dependent on its mother for food for the first year or so of its life. By the time it is 2 years old, it will have enough power, strength, and experience to be able to catch prey for itself. It may start breeding in its fourth or fifth year, and lives on average until the age of 8–10.

TIGER IN ACTION

Tigers in the Ranthambhore reserve in northwest India have been known to charge into lakes after sambar deer and become fully submerged with their prey. The tigers in this area have also been reported to have killed and eaten crocodiles.

Panthera tigris

Tiger

Location S. and E. Asia

Length 1.4–2.8 m (4'7–9'2ft)

Tail 60 cm–1.1 m (2'–3'7ft)

Weight 100–300 kg (220–660 lb)

Social unit Individual

Status Endangered

The tiger is the largest member of the cat family, and its orange coat with black stripes and white markings is instantly recognizable. Its size, coat colour, and markings vary according to subspecies. Although 6 subspecies are recognized, 3 have become extinct since the 1950s, and the 3 remaining are endangered. The geographical distribution of the tiger once extended as far west as eastern Turkey, but it is now restricted to pockets of southern and eastern Asia. The tiger's habitat varies widely, from the tropical forests of Southeast Asia to the coniferous woodlands of Siberia, but its basic requirements are dense cover, access to water, and sufficient large prey. Hunting mainly by night, it takes mostly deer and wild pigs, and cattle in some regions, but it also eats smaller animals including monkeys, birds, reptiles, and fish, and readily feeds on carrion. Tigers will also attack young rhinoceroses and elephants. They may eat up to 40 kg (88 lb) of meat at a time and return to a large kill for 3–6 days. Tigers are usually solitary, but are not necessarily anti-social. A male is occasionally seen resting or feeding with a female and cubs, and tigers may also travel in groups.

CONSERVATION

Between 1900 and 2000, tiger numbers fell from an estimated 100,000 to 3,500 – approximately the figure today. After decades of poaching, habitat loss, and loss of prey, scattered populations survive only in eastern Russia, China, Sumatra, and in southern Asia from Vietnam to India. Although protected in most areas, tigers are still killed where they threaten local farmers, and a large but clandestine trade operates in their skins and body parts, which are used in Chinese medicine. Programmes to save the tiger have met with mixed results, with limited successes set against a trend of overall decline. Radio collars (see below) and anti-poaching patrols give these vulnerable predators at least some protection in the wild.

DISTINCTIVE COAT

The Bengal tiger, Panthera tigris tigris, the most common of the subspecies, exhibits the classic tiger coat: deep orange with white undersides, cheeks, and eye areas; and distinctive black markings. Tiger stripes, which range from brown to jet-black, vary in number, width, and tendency to split. No two tigers have the same markings.

LIVING TIGER SUBSPECIES

The 3 surviving subspecies of tiger differ markedly from one another. In general, those animals from southern areas are smaller and more deeply coloured than their larger and paler northern kin. Tigers that live in cold climates also tend to have thicker fur.

SUMATRAN TIGER

The smallest and darkest of the tiger subspecies is the Sumatran tiger, Panthera tigris sumatrae. Only about 600 are thought to exist today.

SIBERIAN YOUNGSTERS

The Siberian tiger, Panthera tigris altaica, is the largest subspecies, and the lightest in colour, with the longest coat. Its numbers may be as low as 150–200.

REPTILES

Moloch horridus

Thorny devil

Length 15–18 cm (6–7 in)
Breeding Oviparous
Habit Terrestrial
Status Not evaluated

Location W. to C. Australia

Although it is not often seen – partly because it is well camouflaged – the buff, tan, or grey thorny devil is instantly recognizable by its squat shape, its slow way of moving, rocking backwards and forwards as it walks, and its armoury of sharp spines. These cover the whole of its body, with the largest spines on its head and back, and much smaller ones on its legs and feet. Such protection is vital for the thorny devil because, unlike most lizards, it spends a lot of time foraging in one place on the ground, leaving it vulnerable to attack while feeding. Like the desert horned lizard (see p.416), which shares a similar way of life, the thorny devil feeds during the day, when ants are on the move, and can consume up to 2,500 insects during a single meal, catching them with its projecting tongue. Females lay 3–10 eggs in underground burrows in summer.

Physignathus cocincinus

Asian water dragon

Length 50–100 cm (21–31 in)
Breeding Oviparous
Habit Terrestrial
Status Not evaluated

Location S.E. Asia (Thailand, Cambodia, and Vietnam)

The Asian water dragon is a large lizard with a crest of prominent, tooth-like scales from neck to tail and a raised hump on its neck. It has a green body, but the chin and throat are white, pale yellow, or pinkish. Males become brighter in colour during the breeding season. This lizard typically basks near water, into which it may flee for safety, especially when hunted by snakes and birds of prey. It hunts primarily by ambushing its prey, which comprises invertebrates and small vertebrates such as lizards; however, it also forages actively for food, and may occasionally graze upon vegetation. Females lay multiple clutches of 10–15 eggs throughout an extended breeding season, in burrows or shallow scrapes, and cover the eggs with soil and leaves.

Pogona vitticeps

Central bearded dragon

Length 30–45 cm (12–18 in)
Breeding Oviparous
Habit Semi-arboreal
Status Not evaluated

Location Australia

This bulky lizard inhabits dry forest, woodland, and scrubland, resting on stumps or raised humps on the ground, and foraging for small insects and vegetation near its regular perch. If confronted by a predator – usually birds of prey, monitor lizards, or snakes – it erects its black throat frill, or "beard", and presents a wide, open mouth. The males, and even the females, are territorial. The female lays several clutches of 15–30, and occasionally more, eggs throughout the breeding season, burying them in sandy soil. The hatchlings' body markings are more distinctive than those of adults, but they do not possess a beard.

Uromastyx acanthinura

North African mastigura

Length 30–40 cm (12–16 in)
Breeding Oviparous
Habit Terrestrial/ burrowing
Status Not evaluated

Location N. Africa

The North African mastigura has a short, thick, armoured tail that it uses to block the entrance to its burrow to deter predatory birds or mammals. Inside the burrow, it inflates its body to wedge itself in. It may also use its tail as a club and may bite if cornered. Males, and occasionally females, are aggressively territorial. The coloration of this lizard varies according to temperature: grey or yellowish brown in cold weather, when it hibernates, changing to orange, red, yellow, or green when active. It emerges only on warm days, basking and orientating its body to the sun, until its body temperature is high enough for foraging. Its diet consists of insects and plants, and it may walk over 1 km (⅔ mile), zig-zagging across rocky outcrops in the desert, to find favoured plant species. Females lay at least 2 clutches of 20–30 eggs a year, then bury them in side chambers off the main burrow, smoothing over the nest to disguise the site.

Bradypodion thamnobates

Natal Midlands dwarf chameleon

Length 15–19 cm (6–7 in)
Breeding Viviparous
Habit Arboreal
Status Near threatened

Location Southern Africa (Kwa-Zulu Natal)

Dwarf chameleons are largely restricted to southern Africa, where they live in forest and scrub. They differ from most other chameleons in giving birth to live young. The Natal Midlands dwarf chameleon is a typical species, with a high protuberance, or casque, covering its neck. Its coloration is highly variable, but the long-tailed males, which are often green, are more colourful than the females and juveniles, which are brown or grey. Like other chameleons, it is specially adapted for life in trees, and feeds on insects, which it captures with its long, sticky tongue.

Rhampholeon spectrum

Western pygmy chameleon

Length 7–10 cm (2¾–4 in)
Breeding Oviparous
Habit Partly arboreal
Status Least concern

Location W. to C. Africa

This tiny chameleon – one of the world's smallest – lives in rainforests, where it is camouflaged by its leaf-like colour and shape. Unlike most chameleons, its ability to change colour is limited. It hunts in leaf litter and on low branches, hiding in shrubs at night.

Furcifer pardalis

Panther chameleon

Length 40–52 cm (16–20½ in)
Breeding Oviparous
Habit Arboreal
Status Not evaluated

Location Reunion Island, S. and N. Madagascar

Madagascar and its neighbouring islands have over 70 species of chameleons, which is more than in any similarly sized region of the world. The panther chameleon, particularly the adult male, is one of the most brightly coloured, with a bewildering array of colour schemes, including green, brick-red, turquoise, or any combination of these hues. It can change its colour rapidly, but it usually retains its bright lateral stripe. Panther chameleons live in lightly wooded, scrubby habitats, and catch insects and other small animals by shooting out their sticky tongues, which can be longer than the rest of their bodies. They are usually slow-moving, but at the onset of the breeding season, males fight for territories. Each year, females lay several clutches of 12–50 eggs, burying them in moist soil.

FLATTENED SNOUT
One of the larger chameleons, the panther chameleon has a long, flattened region on top of its snout, fringed with enlarged scales. The male has a small nasal appendage, while the female (shown left) has none.

CHANGING COLOUR

Chameleons are famous for being able to change colour for camouflage, but in most species, colour is equally important as a means of communication. Male panther chameleons attract females by producing sudden flushes of colour, while females change colour when pregnant to signal that they are not receptive to mating.

Furcifer oustaleti

Oustalet's chameleon

Location Madagascar

The largest of all the chameleons, this species is rather dull in colour – brown with a few yellow, red, or greenish spots – and has no horns. However, it has a large, flattened casque (protuberance) over its head and neck. Unusually for a chameleon, the male is less colourful than the female, but he becomes more flushed with colour during courtship. Females lay approximately 50 eggs, in soil or leaf litter. Slow and deliberate in its movements, Oustalet's chameleon carefully stalks prey such as insects and small vertebrates before capturing them with its extendible, sticky tongue. It defends itself against predatory snakes and birds by inflating its body, presenting its side to the enemy, and opening its mouth wide; it may also hiss and bite.

Trioceros jacksonii

Jackson's chameleon

Length 20–30 cm (8–12 in)
Breeding Ovoviviparous
Habit Arboreal
Status Not evaluated

Location E. Africa, introduced in Hawaii

With their 3 forward-pointing horns, males of this species are among the most distinctive of all chameleons, and at one time were often caught and sold as pets. Both sexes have a flattened body and serrated crest along the back, with a bony casque over the neck. Their normal colour is green, but specimens that live in East Africa's mountain forests are usually brighter and larger than ones that live lower down. Jackson's chameleon relies primarily on its camouflage to avoid being attacked. However, if cornered, it inflates its body and gives a menacing hiss. Females are ovoviviparous, producing 2 litters of up to 50 young each year. Newborns are light brown, but turn green at about 4 months. In males, horns start to form about 2 months later. In the wild, the lifespan of Jackson's chameleon is probably 2–3 years.

HORNS ON MALE
The male Jackson's chameleon has 3 long, pointed, bony horns on the front of his head, used in fights with other males over territory.

HORNLESS FEMALE

Male and female Jackson's chameleons are easily told apart: the female (shown above) is usually stockier than the male, and the horns are tiny or absent.

Calumma parsoni

Parson's chameleon

Length 50–60 cm (20–23½ in)
Breeding Oviparous
Habit Arboreal
Status Not evaluated

Location N. and E. Madagascar

This very large, deep-bodied chameleon is usually greenish, but may also be blue. The male is larger and more colourful than the female, with a larger casque (protuberance) on the top of the head and a warty, flattened horn – absent in females – on the snout. Parson's chameleon lives mainly in the trees and is slow-moving, relying on camouflage to escape detection. Defensive behaviour includes inflating its body, hissing, or biting, and it may become more brightly coloured. Males of this species are highly territorial, and mate with receptive females without preliminaries. The female lays 16–38 eggs, burying them in a hole dug in moist soil.