

LILY MURRAY

JESSE HODGSON



# OUR TIME ON EARTH

ANIMAL LIFESPANS FROM THE MAYFLY  
TO THE IMMORTAL JELLYFISH



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# OUR TIME ON EARTH





*For my father, and his love of nature – L.M.  
Dedicated to Olive – J.H.*

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B P P



# CONTENTS

OUR TIME ON EARTH .....	6
MAYFLY .....	8
HONEY BEE .....	10
MONARCH BUTTERFLY .....	12
PYGMY GOBY .....	16
LABORD'S CHAMELEON .....	18
OPOSSUM .....	20
ETRUSCAN SHREW .....	21
GIANT PACIFIC OCTOPUS .....	22
AXOLOTL .....	24
PERIODICAL CICADA .....	26
TRAPDOOR SPIDER .....	28
GRIZZLY BEAR .....	30
BRANDT'S BAT .....	32

ECHIDNA .....	34
ORANGUTAN .....	36
LAYSAN ALBATROSS .....	38
KAKAPO .....	42
AFRICAN ELEPHANT .....	44
SALTWATER CROCODILE .....	46
AMERICAN LOBSTER .....	48
ORANGE ROUGHY .....	50
GALÁPAGOS GIANT TORTOISE .....	52
BOWHEAD WHALE .....	54
GREENLAND SHARK .....	56
OCEAN QUAHOG .....	58
GLASS SPONGE .....	59
IMMORTAL JELLYFISH .....	60
TIMELINE .....	62

# OUR TIME ON EARTH

For some creatures, 'life' means just a few weeks or months on Earth. For others, a lifetime can span hundreds, even thousands, of years. Be it long or short, an animal's allotted lifespan, encoded within its DNA, dictates so much about the way it lives.

Short-lived animals are in a race against the clock from the moment they are born, needing to mature fast enough to have young of their own before they die. Long-lived animals can take their time, living out their days at a more leisurely pace. Think of a mouse – its life is usually over within two short years, while a two-year-old elephant is still a baby, suckling milk, never far from its mother's side.

But why is life so brutally short for some and so long for others? Why is it that the Labord's chameleon (see pages 18-19), in the forests of Madagascar, will never know the dry season? Its five months of existence start and end with the rains. How is it that a giant tortoise (see pages 52-53) can live to a hundred and go for a year without eating, but a pygmy shrew (see page 21) must frantically find food every two hours to survive?

Does the power of flight bring with it the gift of longer life? And why do so many of the longest-lived creatures inhabit the freezing waters of the deep?

This book seeks the answers to the secrets of longevity. It also reveals how understanding an animal's lifespan can bring with it intriguing insights into their existence, as well as vital information as to how best to protect them.

Along the way, you'll meet a fascinating array of creatures, from the gossamer-winged mayfly to the curious axolotl and the majestic albatross.

Read on to discover what these amazing animals make of their time on Earth...



# MAYFLY

LIFESPAN: 5 MINUTES TO 24 HOURS

Fast, fleeting and fascinating... the adult mayfly's lifespan is one of the shortest in the animal world. From the moment a mayfly emerges in its adult form, it is in a race against time to find a mate and breed.

A mayfly's life begins in the water. For up to two years, a young mayfly lives in its nymph (or larval) stage at the bottom of ponds, lakes and rivers, feeding on algae and plants. When a nymph reaches its adult stage, it floats to the surface. There, its outer layer splits open and it is reborn, with wings.

At first, an adult mayfly is dull-coloured and seeks shelter in the vegetation along the bank. But a few hours later, it sheds its skin one last time, and transforms itself into its final, delicate form, with shiny body and translucent wings.

The clock is now ticking. Most mayflies have under 24 hours to fulfil their purpose. For one species, *Dolania americana*, there is only a brief five minutes.

The males gather above the water in huge swarms. Females join them in the search for a mate. This is feast time for predators. Birds swoop through the air with open beaks, frogs flick out their sticky tongues while fish leap from the water.

After mating, the female falls back down to the water, dipping her abdomen below the surface to lay her eggs. When she is spent, she dies in the water, while the males fly to ground nearby to die. The eggs sink to the bottom, where they stick to plants and stones. A few days to a few weeks later (depending on the species), the eggs hatch into tiny nymphs, and the life cycle begins again.

An adult mayfly's life may be short, but mayflies have been on Earth for more than 300 million years. Today, they survive only in unpolluted water, where the adults still haze the air with their fleeting day-long dance.

# HONEY BEE

LIFESPAN: 5 TO 7 WEEKS

A worker honey bee born in the spring only lives for five to seven weeks, but not a day of her life is wasted. While it is the role of the queen bee to lay eggs, and the male drone bees to mate with a queen, it is the workers who keep the hive running. Throughout her life, a worker will take on an astonishing number of tasks, changing her roles as she ages.

## DAYS 1 TO 3

A worker bee emerges from her cell. She is around 1.5mm in length and weighs just 100mg. One of her first tasks is to clean out her cell to make sure it is spotless and polished, ready to receive new eggs or to store pollen and nectar.

## DAYS 7 TO 12

A select few of the workers become the queen's attendants, feeding and grooming the queen. While attending her, they are covered in her scent, known as the queen mandibular pheromone (QMP). The attendants then spread QMP throughout the hive, which ensures all the bees remain loyal to their queen.

## DAYS 3 TO 16

During the first two weeks of her life, a worker bee may take on the role of a mortuary bee. It is her job to remove any dead bees and larvae that have failed to develop.

A worker bee may also act as a nurse bee, caring for the developing larvae by keeping them clean and feeding them a mixture of honey and pollen, known as 'bee bread'. Nurse bees will check on a single larva around 1,300 times a day.

## DAYS 12 TO 18

By day 12, young worker bees will become pollen packagers, taking nectar and pollen from foraging bees that are returning to the hive, and placing them in cells. The pollen will then be mixed with honey and stored as food for the colony.

During this time, worker bees will also take turns as fanning bees, using their wings to keep the hive cool.

## DAYS 12 TO 35

At around twelve days old, a worker bee is able to produce wax flakes from her abdomen, which are used to build new wax combs in the hive. The wax is also used to cap the cells of pupae (bees at the stage between larvae and fully-grown), and cells filled with ripened honey.

## DAYS 18 TO 21

The last task of a worker bee within the hive is to protect it from intruders. By day 12, her glands have filled with venom, so that she can defend the hive from attack. She stands guard at the hive entrance, checking each bee that returns for its familiar scent.

## DAYS 22 TO 42

The worker bee is now halfway through her life, and her time outside the hive is about to begin as she takes on the role of forager bee.

As a forager, she will visit up to 40 flowers a minute, and may visit more than 1,000 flowers a day. As she flies, she will fill the pollen baskets on her back legs and suck up nectar, storing it in a special honey stomach.

At the end of her time, she will probably die in the field, to be seamlessly replaced by the new worker bees emerging from their cells.

# MONARCH BUTTERFLY

LIFESPAN: 5 WEEKS TO 8 MONTHS

Most monarch butterflies spend their lives on a journey they will never finish. Each year, the butterflies wake from their winter sleep in Mexico, to fly north along the coast of America, all the way to Canada. As these butterflies only live for two to six weeks, their journey is one that will take two to three generations to complete. But for the last generation of monarchs, it is a very different story...

Over winter, monarch butterflies sleep in clusters in oyamel fir trees, high in the Mexican mountains. They wake from their hibernation in February and March, taking to the air in search of a mate, before flying a few hundred kilometres north, in search of milkweed plants on which to lay their eggs.

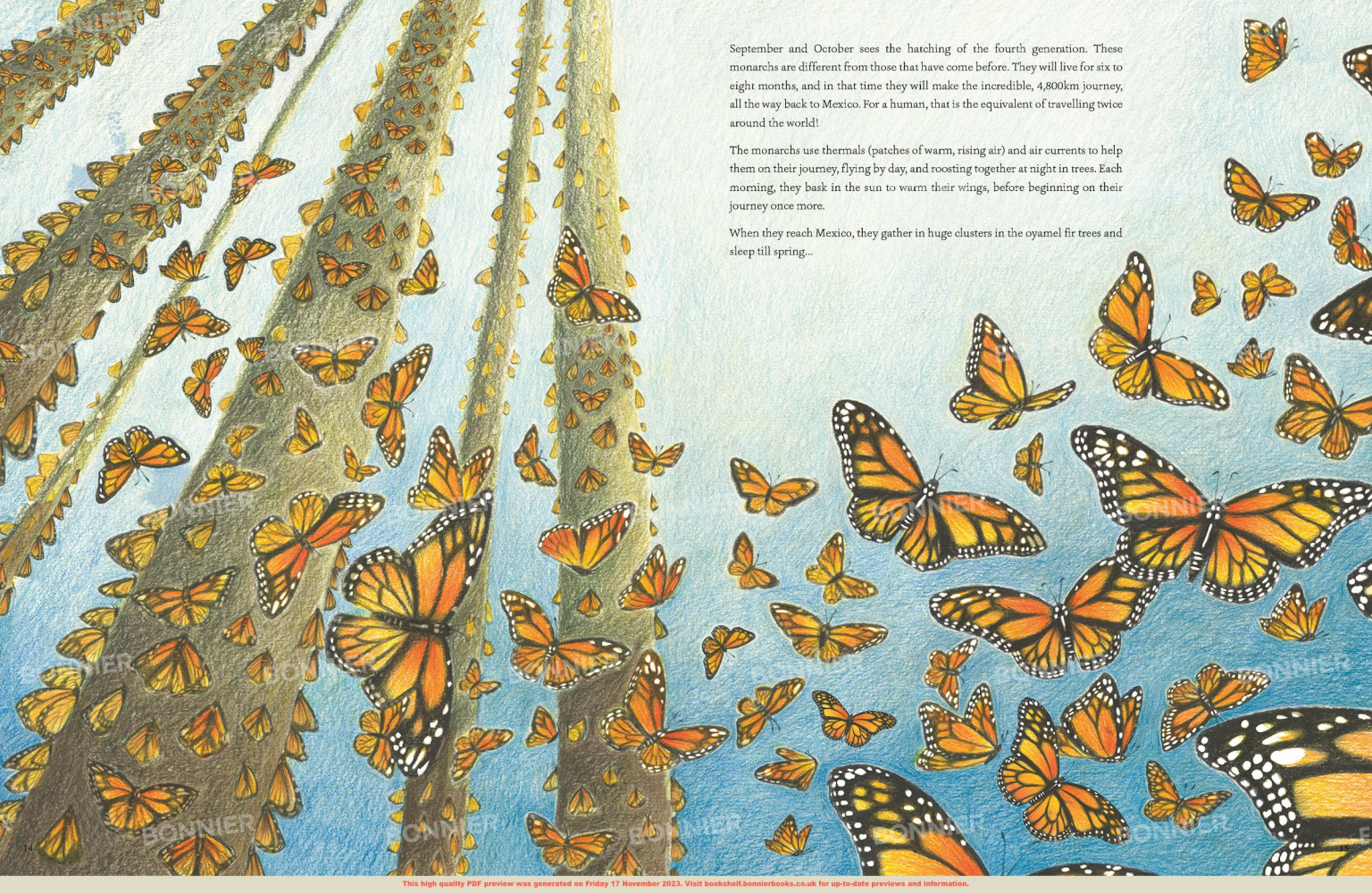
By April, the females have laid their eggs (up to 500), dying soon after. The eggs take around four days to hatch into tiny, pale green, shiny caterpillars. The caterpillars begin by eating their own eggshells, before feasting on the leaves of the milkweed plant.

It takes just ten days for a new monarch butterfly to emerge from its chrysalis. It then flies on, always heading north, feeding on flowers along the way. After five to six weeks, the females lay their eggs, giving way to the next generation of monarchs.

For the next three months, the cycle continues. In May and June, the second generation are usually born, and the third in July and August. Like the monarchs before them, these butterflies will hatch, mate and fly north, laying their eggs before they die.

Two weeks later, and the caterpillars are fully grown. By now, they are covered in vivid gold, black and white stripes. They begin to move further away from the milkweed plants, then attach themselves to a stem or leaf using silk, and envelop themselves in a chrysalis - a hard, protective outer layer.





September and October sees the hatching of the fourth generation. These monarchs are different from those that have come before. They will live for six to eight months, and in that time they will make the incredible, 4,800km journey, all the way back to Mexico. For a human, that is the equivalent of travelling twice around the world!

The monarchs use thermals (patches of warm, rising air) and air currents to help them on their journey, flying by day, and roosting together at night in trees. Each morning, they bask in the sun to warm their wings, before beginning on their journey once more.

When they reach Mexico, they gather in huge clusters in the oyamel fir trees and sleep till spring...

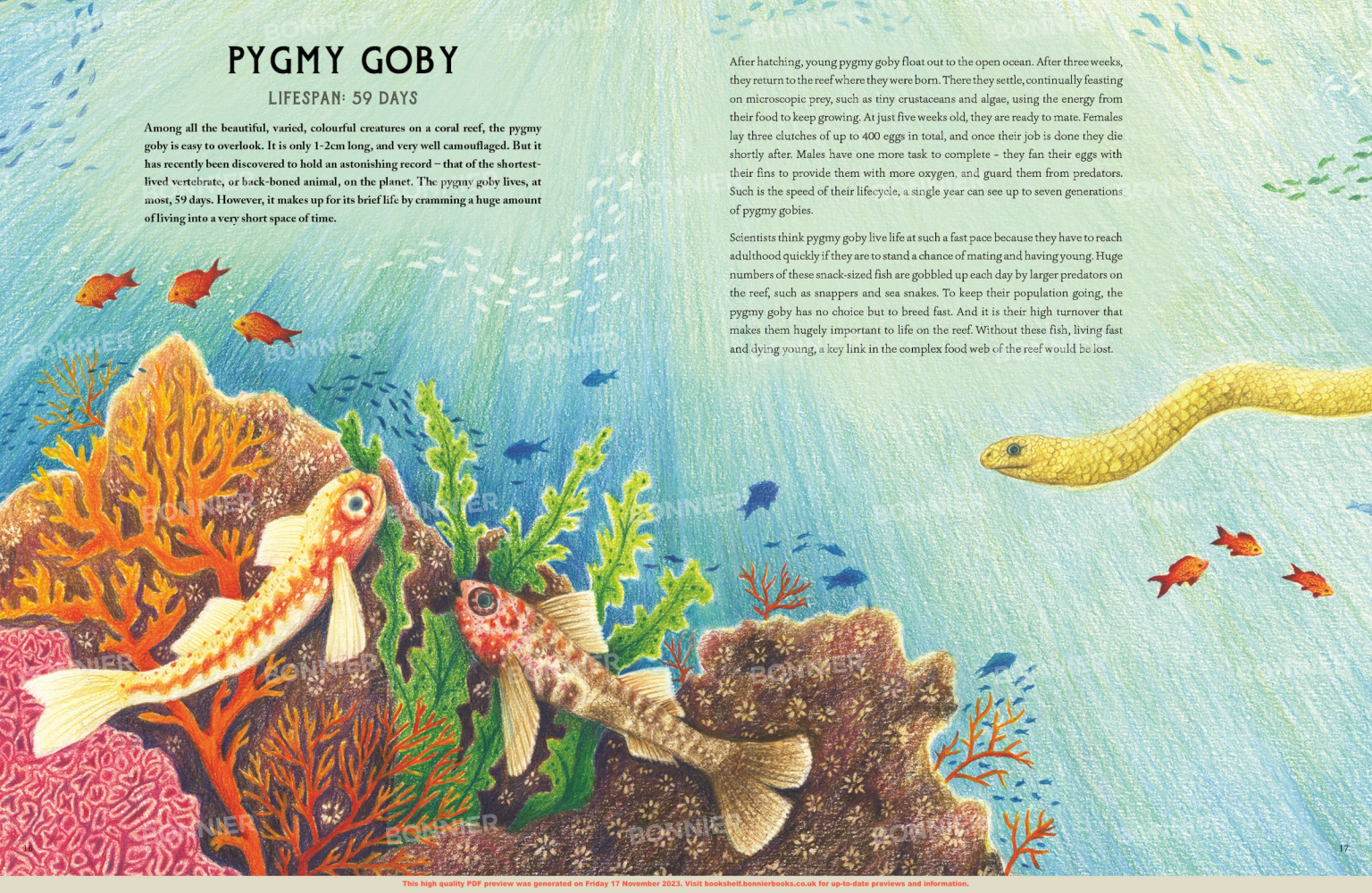
# PYGMY GOBY

LIFESPAN: 59 DAYS

Among all the beautiful, varied, colourful creatures on a coral reef, the pygmy goby is easy to overlook. It is only 1-2cm long, and very well camouflaged. But it has recently been discovered to hold an astonishing record – that of the shortest-lived vertebrate, or back-boned animal, on the planet. The pygmy goby lives, at most, 59 days. However, it makes up for its brief life by cramming a huge amount of living into a very short space of time.

After hatching, young pygmy goby float out to the open ocean. After three weeks, they return to the reef where they were born. There they settle, continually feasting on microscopic prey, such as tiny crustaceans and algae, using the energy from their food to keep growing. At just five weeks old, they are ready to mate. Females lay three clutches of up to 400 eggs in total, and once their job is done they die shortly after. Males have one more task to complete - they fan their eggs with their fins to provide them with more oxygen, and guard them from predators. Such is the speed of their lifecycle, a single year can see up to seven generations of pygmy gobies.

Scientists think pygmy goby live life at such a fast pace because they have to reach adulthood quickly if they are to stand a chance of mating and having young. Huge numbers of these snack-sized fish are gobbled up each day by larger predators on the reef, such as snappers and sea snakes. To keep their population going, the pygmy goby has no choice but to breed fast. And it is their high turnover that makes them hugely important to life on the reef. Without these fish, living fast and dying young, a key link in the complex food web of the reef would be lost.



# LABORD'S CHAMELEON

LIFESPAN: 4 TO 5 MONTHS

The Labord's chameleon spends most of its life as an egg. These lizards live in the forests of Madagascar, but for eight months of the year, during the dry season, their eggs slowly incubate in burrows in the sand. When the rains arrive in November, all the eggs hatch at once. The tiny chameleons that emerge have a short, brutal life ahead of them. They have just five months to reach adulthood and breed, making them the shortest-lived (and fastest-growing!) four-legged animals on Earth.



On hatching, the tiny chameleons scamper through the branches of the trees, lassoing insects and spiders with their long tongues. They eat so much they grow at a rate of 2.6mm a day. Many, however, will fall prey to snakes, birds and monkeys. Those that make it to January are fully grown and ready to mate. The males turn a bright asparagus-green, while the females put on a dazzling display of colour to attract mates, turning speckled violet, blue, yellow and green. After mating, females dig burrows in the sand to lay their eggs, then die, with the males following them to their deaths soon after. At this time, weak, older chameleons can be seen falling from the trees, like dried-up leaves. By April, the forests are once again empty of chameleons. Only their eggs remain, buried in the hot dry sand.

It seems an extreme life cycle, but it ensures the chameleons are able to survive changes in climate, from the hot dry season when there is little to eat, to the explosion in insect life that comes with the rains.

# OPOSSUM

LIFESPAN: 1 TO 2 YEARS

Although they grow to be the size of a cat, at birth, a baby opossum is no bigger than a honey bee. A newborn's first act, naked and blind, is to crawl to its mother's pouch, where it must latch on to one of her teats if it is to survive. There, the surviving babies will stay for up to seventy days. As they develop, they spend more and more time outside the pouch, occasionally hitching a ride on their mother's back, before they learn to clamber about by themselves. By just six to eight months, an opossum is fully developed, and ready to breed.



Opossums' lives are so short, in part, because there are so many predators around. Opossums that live on islands, where there are fewer predators, have been found to breed later in life. They are able to keep producing litters for longer, and live longer lives.

Interestingly, however, all marsupials have shorter lives for their body size compared to other mammals, and scientists do not yet know why.

# BONNIER ETRUSCAN SHREW

LIFESPAN: 1 TO 2 YEARS

While opossums are one of the shortest-lived marsupials, shrews are among the shortest-lived mammals. At birth, all mammals (other than humans) have the same lifetime supply of heartbeats: a limit of around one billion. Smaller mammals tend to live shorter lives than larger mammals because their hearts beat more quickly. This is particularly true of the Etruscan shrew, one of the world's smallest mammals, which burns through its heartbeats at a furious rate of up to 1,500 beats per minute.



It is not only the shrew's heart that beats quickly - it does everything in the fast lane. A shrew is constantly on the move, and to keep going, it needs to keep eating, snuffling through the undergrowth in search of insects and spiders. Many shrew species must eat their own body weight in food each day in order to survive. Even a few hours without food can mean death, so shrews never nap for more than a few minutes at a time.

Most shrews won't make it past their first birthday, as they fall prey to owls, snakes and even trout. But in shrew-time, that's still long enough to have a litter or two of babies and beat out, if not all their allotted billion heartbeats, then something close to it.

# GIANT PACIFIC OCTOPUS

LIFESPAN: 3 TO 5 YEARS

The largest of all the octopuses, the giant Pacific octopus begins life no bigger than a grain of rice. On hatching, it looks like a miniature adult, with eight tiny arms and fourteen tiny suckers. At first, a baby octopus drifts on the surface of the ocean, eating plankton, but after three months it settles on the sea floor. There it lives, hunting and growing, until it is three years old. By now, it may weigh more than 15kg, with an arm span of up to 5m. And at last, it is ready to breed.

This, however, is a risky business. Females have a habit of eating males while mating. If they both escape from this encounter alive, the male still dies soon after, while the female heads to a den in deeper water. There, a month later, she lays tens of thousands of tiny eggs, which she weaves together into strands, hanging them from the roof of her den.

The laying of eggs marks the beginning of the end for the female octopus. She will live on for seven more months, watching over her eggs, barely eating and never leaving them. She fans her eggs with her arms or contracts her body and shoots out streams of oxygen-rich water to nourish them. She delicately cleans them with her suckers to keep them clear of algae. Finally, she watches her eggs hatch and float to the surface. But she will not follow them or parent them, for she too is out of time. She has done all she can to help the next generation to survive.

Octopuses are remarkably intelligent. They can solve problems, play tricks and even mimic each other. Unlike most other intelligent creatures, however, they spend most of their lives alone and their time on Earth is short. Why have octopuses evolved to live such brief lives with such amazing intelligence? What is the point of developing such a complex brain, if the octopus doesn't have much time to use it?

Perhaps, scientists think, it is because they are so vulnerable to predators. They have no external shell to protect them, but their soft bodies are agile and nimble and can fit into astonishingly small spaces. They rely on their large brains to get them out of trouble - they are able to camouflage themselves in an instant. But even with all this trickery, a soft-skinned octopus cannot expect to survive long in the predator-filled sea. Just as their bodies can squeeze into the smallest of spaces, so they must squeeze the stages of their lives into an all too brief lifespan.

# AXOLOTL

LIFESPAN: 10 TO 15 YEARS

The axolotl is a strange, alien-looking creature, found only in the lakes and canals near Mexico City. A species of tiger salamander, it spends its life skulking through the water on its lizard-like legs, sucking up fish, worms, insect larvae and crustaceans in its wide, smiling mouth. But what makes the axolotl really remarkable is that unlike other salamanders, and almost all other amphibians, it very rarely develops into its final land-living stage.

On hatching, an axolotl has gills, rising in feathered pairs from either side of its head, and a little fin, that runs the length of its body. It also has very basic lungs, which allow it to gulp air from the surface. But while most other amphibians go on to lose their tail and gills and develop their lungs, the axolotl keeps its larval form all its life. Like a tadpole that never grows up, it can never leave the water.

In the past, this gave the axolotl an advantage. By not putting its energy into transforming its body, the axolotl is able to reproduce sooner. From six to twelve months of age, axolotls are ready to breed, searching for mates in the murky water. They can breed several times a year, and lay many eggs. For ten thousand years, this has ensured their survival in Mexico's ancient lakes and waterways.

Today, however, the axolotl is racing towards extinction in the wild. All that remains of its habitat are about 170km of canals, highly polluted and teeming with predators, such as carp and tilapia, introduced by humans just 50 years ago. Axolotls thrive around the world only as pets, or in laboratories, where scientists seek to unlock their secrets.

Axolotls have long been seen as almost mythical creatures. They are named for Xolotl, a dog-headed god from Aztec mythology, who is said to have transformed himself into an axolotl to escape being sacrificed. And scientists have discovered that axolotls really do have amazing 'superpowers': they are able to regrow missing limbs, without any scarring, and can rebuild their jaws, spine and even parts of the brain.

# PERIODICAL CICADA

LIFESPAN: 17 YEARS

Periodical cicadas are one of the longest-lived insects. They also have one of the most extraordinary life cycles. Their journey begins deep beneath the soil where, for 17 long years, they live sucking on the juice, or sap, that flows through tree roots.

In the darkness, the cicadas go through five stages of development. It takes them a long time to pass through each stage, as the sap they feed on is full of sugar but lacking in nutrients. Then at last, after seventeen years have passed, and when the soil reaches 18°C, they emerge from the ground, sometimes in their millions.

Together, the cicadas make their way up the trunk of the tree on which they have been feeding for all those years. Then they shed their skins one last time and emerge with soft white bodies and wings.

First, the cicadas wait for their bodies to harden, turning a dark, earthy brown. They now have bright red eyes and transparent, orange-flecked wings. Then the males begin to sing, making a strange reverberating sound that fills the air. The females respond by flicking their wings: click! click! click!

After mating, the females lay their eggs using a special tube, called an ovipositor, on the tip of the abdomen. Sharp and pointed, the females use their ovipositor like a sword, slicing into the tree to lay their eggs.

As adults, cicadas only live five to six weeks. They disappear almost as quickly as they came, leaving only their eggs and their larval skins behind. Why the strange life cycle? Scientists think it could be that by emerging after such a long time underground, they escape the life cycle of their would-be predators. And how can the cicadas tell when 17 years has passed? Nobody knows. It is one of nature's mysteries.

# TRAPDOOR SPIDER

FEMALE LIFESPAN: 20 TO 43 YEARS

MALE LIFESPAN: 5 TO 7 YEARS

**How long does a spider live for? For a common house spider, only a few years. For a tarantula, possibly 20 years or more. But the oldest-known spider, an armoured trapdoor spider, was an astonishing 43 years old when she died. She spent her entire life in one tiny patch of southwest Australia, beneath the branches of an acacia tree.**

This trapdoor spider began her life nearby, in her mother's silk-lined burrow. There she lived for six months, until the arrival of the autumn rains. Then her mother unsealed the burrow, releasing her and her fellow spiderlings into the world. Her story went a little like this...

Now free, her first task was to build a burrow of her own. First, she made a circle in the earth, just a fraction larger than her body, then dug down into the soil. She lined her burrow with silk, just as her mother had done before her. Across the tunnel's entrance, she weaved a silken door, attached on one side, so it could open and close. Finally, she collected hundreds of twigs, dragging them to her doorway, creating a beautiful spiral pattern. She never left this burrow. She stayed there until she died.



The trapdoor spider then waited - sometimes for days, sometimes for weeks - for an insect to come near. As soon as she felt the vibrations from movement on the twigs, she scuttled out, grabbed her insect prey and dragged it back to the burrow.

She grew slowly, moulting her hard exoskeleton when it became too small. Her new skin was soft, making her vulnerable to predators. But after a few days, it hardened into a protective shell. After each moult, she enlarged her burrow. If the door was pulled off, most often by a bird, she would reattach it. She kept her twigs in perfect order.



One day, she emerged from her burrow and weaved a mat, scented with pheromones. Then she returned to her burrow, to wait for a male spider to come to call. Any male who takes up such an offer is reaching the end of his life, and will die soon after mating, at around six years of age. Our female, however, returned to her burrow again, sealed the entrance so nothing could get in - not the rains, nor heat, nor predators. There she stayed, brooding over her eggs, and then the spiderlings when they hatched.

It was a simple life - growing, moulting, spinning, feeding and brooding - lived for the most part alone, and in the darkness of her burrow. A simple life, but a long one.



# GRIZZLY BEAR

LIFESPAN: 20 TO 30 YEARS

It is October and winter is coming, but this female grizzly bear is ready. She has a den, a cosy hole lined with grass, leaves and moss. All summer, she feasted as much as she could to put on enough fat to last her through the winter. She gorged on salmon from the river and then, when autumn rolled in, she searched for seeds, nuts and berries. Now, as the temperature drops, she settles down to sleep. Her body temperature falls from 38°C to 33°C. Her heart rate slows to below a quarter of its normal rate. Her sleep is not as deep as hibernating animals – she can wake at the slightest disturbance, ready to defend herself in case of attack – but left undisturbed, she will sleep for four to seven months.

Amazingly, pregnant females even give birth during their winter rest. The cubs, born tiny, blind and hairless, will suckle from their mother as she sleeps, warming themselves in the thick fur of her belly.

When a female grizzly bear finally rouses in the spring, she will have lost a third of her body weight. By then, her cubs are ready to face the world. They have grown strong on their mother's milk, with thick fur coats of their own. Their mother will take them out into the world, teaching them how to hunt and what to eat, and they will stay with her for up to four years.

Grizzly bears spend between a third and half of their lives asleep. Their long winter rest is a strategy for survival, as there is little food in the winter months. And it is a strategy that works. Animals that spend winter in a deep sleep tend to have longer lives than animals that don't, as they are much less likely to die during winter. It works not just for individuals, but as a species: grizzly bears have been sleeping through icy winters on Earth now for over a million years.

# BRANDT'S BAT

LIFESPAN: 40 YEARS

Bats are a hugely successful animal group, making up a fifth of all known mammal species. They are the only mammals that can truly fly, on wings made of thin skin stretched between their elongated fingers. Most are nocturnal, and to help them navigate in the dark and track down prey, they use echolocation: sending out sounds and then listening to the returning echo.

When it comes to lifespans, bats break all the rules. Most mammals with small body sizes live shorter lives (see page 21), but scientists have found 22 bat species that live for more than 20 years, and 5 bat species that live for more than 30 years. The insect-eating Brandt's bat weighs just 4-8g but lives for around 40 years - giving it a longer lifespan than any other mammal for its body size. One Brandt's bat, captured in Siberia in 2005, was 41 years old, and showed no signs of ageing. So how do bats manage to live such long and healthy lives?

It is partly down to the power of flight. Most flying animals, including birds, live longer than animals of a similar size, as being able to fly means they are able to escape from predators more easily. Bats live together in flocks, which makes them less likely to be picked off by predators. Vampire bats, one of the longest-lived bat species, will also keep each other from starving. Female vampire bats have been recorded sharing blood from meals.

Most long-lived bat species hibernate. They are able to lower their body temperature and sleep through long winters, enabling them to survive when there is less food to be had, often in the safety of caves. In Siberia, the Brandt's bat has one of the longest hibernation periods, from late September to the middle of June, giving it just three months of activity each year.

Scientists are now studying the genes of bats, to see how their DNA helps them to live for so long. If humans lived as long as bats, adjusted for size, we'd have lifespans of 240 years. It could well be that bats hold the answers to humanity's search for longer and healthier lives.

# ECHIDNA

LIFESPAN: 45 YEARS

Echidnas are one of the world's oldest living mammals. They have been around for millions of years, surviving even the mass extinction that wiped out the dinosaurs. Today, along with duck-billed platypuses, they are the only living members of an ancient group of egg-laying mammals, called monotremes, that once dominated Australia. There are just four species: the short-beaked echidna, still found in Australia, and three species of long-beaked echidna, all endangered, found only in the hill forests of Papua New Guinea.

Adult echidnas are covered in prickles, with short, stubby legs and long, fleshy noses, which they use to pick up electrical signals from their insect prey. Among their many curious habits are the 'love trains' which males form at the beginning of the breeding season. During the winter months, up to 11 male echidnas can be seen queuing nose to tail, forming long trains behind a female, all hoping to become her mate.

Around two weeks after mating, a female echidna lays a soft, leathery egg, which she places in a pouch on her stomach. On hatching, a baby echidna, known as a puggle, is no bigger than a jelly bean. With tiny claws, its clings onto its mother's pouch hair, lapping at milk, which she secretes through glands at the front of the pouch.

A puggle stays in its mother's pouch for around seven weeks, until its prickles begin to emerge. The mother then places her spiky baby in a burrow, returning to it every five to ten days to give it milk and food, until at around seven months, it is ready to make its own way in the world.



At 32°C, echidnas have the lowest active body temperature of all mammals except the platypus. Scientists think this, coupled with their slow metabolism, is the key to echidnas' long lives. They have been reported to survive for up to 45 years in the wild.

Echidnas also have the ability to lower their body temperatures further still, which puts them into a state known as torpor, in which they barely eat or move, for up to days at a time. This helps them to survive when their habitat is struck by bush fire, as frequently happens. By hiding in an underground burrow, or inside fallen logs, they can be protected from the raging flames, and afterwards, when food is scarce.

What we know of echidnas makes them both puzzling and fascinating. These elusive and ancient creatures have only recently been studied in the wild, so we are just beginning to unravel their mysteries.



# ORANGUTAN

LIFESPAN: 45 YEARS

Orangutans are great apes, and one of our closest relatives. The name means 'person of the forest' and they are found in the rainforests of Borneo and Sumatra. There, they live long, slow lives, high up among the treetops.

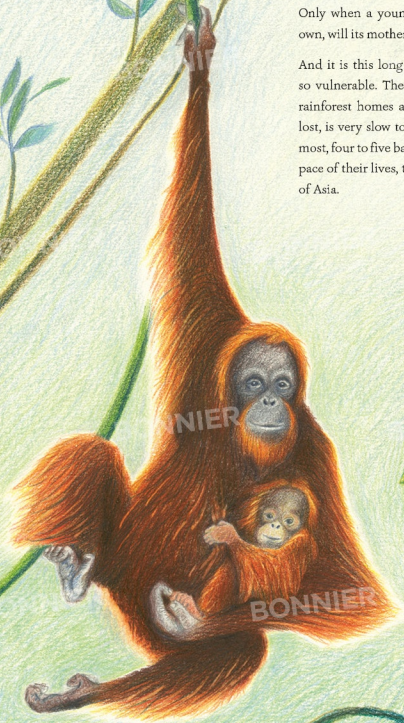
An orangutan moves by clambering from branch to branch, cautiously climbing, rarely jumping. Each day is spent mostly eating, with nearly half their time spent at rest. In the evening, an orangutan will build a treetop nest out of leafy branches, usually in a different place each night.

Sumatran orangutans are the slowest to grow and breed of any land mammal. A mother will give birth to her first baby at around 15 years old, and will have just one baby at a time.

For the first four to five years of its life, a baby Sumatran orangutan clings to its mother's fur as she moves through the forest, until it has the strength and agility to clamber about on its own. A baby will then stay with its mother until it is eight years old, suckling on her milk and learning the ways of the forest. The bond between them is incredibly strong.

This long childhood - the longest in the animal kingdom apart from humans - is vital for an orangutan's survival. These intelligent creatures have so much to learn, from the fruits they can eat, to nest-building, to how to collect termites from a nest, or make a leaf-umbrella in the rain. Only when a young orangutan is ready to survive on its own, will its mother breed again.

And it is this long childhood that also makes orangutans so vulnerable. They are losing their habitat, fast, as their rainforest homes are chopped down. A population, once lost, is very slow to recover. Each female will only have, at most, four to five babies in her lifetime. Despite the leisurely pace of their lives, time is running out for the last great ape of Asia.



# LAYSAN ALBATROSS

LIFESPAN: 50 YEARS

On a tiny speck of an island, in the middle of the North Pacific Ocean, over 3,000km from the nearest continent, a female Laysan albatross, called Wisdom, comes in to land. She is around 70 years old (the world's oldest known wild bird), and she has come to meet her mate.

Laysan albatrosses are one of the longest-lived birds. They spend most of their lives at sea, typically gathering on remote, far-flung islands, in order to breed. With wingspans of nearly 2m, they soar over the open ocean, riding the wind and using their wide wings to glide for hours without rest.

But once every year or two, an albatross leaves its ocean life to begin the arduous task of raising a chick. An albatross will always return to the same nest site, in the hope of meeting its mate from previous years. For Wisdom, this is a male named Akeakamai. When they meet, they court each other, to reaffirm the bonds that can last a lifetime. They touch bills, then mirror each others' movements: bobbing their heads, placing their bill under a wing. Then they sit together, preening each other and snuggling up close. Only then is it time to mate.



A female Laysan albatross lays just one egg, for the parents can only care for one chick at a time. First, they take turns sitting on the egg, while the other heads out to sea to hunt for food. After two months, the egg is ready to hatch, and the parents will need to care for the chick for five more months. With luck, the fledgling will then successfully take to the skies, to spend its first three years at sea, without ever touching land.

Each egg is vitally important to the survival of the species. Albatrosses face many threats: rising sea levels, temperature changes, increasing storms, death from fishing equipment and plastic. Mammals, such as mice and rats, introduced by humans onto their nesting islands, feast on their eggs and chicks. The numbers of these feathered giants are now falling fast. Hope lies in grand matriarchs like Wisdom, returning year after to year to raise the next generation.



To feed, an albatross will swoop down to the sea's surface, catching fish, octopus, squid and cuttlefish in its large bill. Some species can circle the globe in search of food, covering almost 800km a day at speeds of 80kmph.

# KAKAPO

LIFESPAN: 60 TO 100 YEARS

Solitary, fat and flightless, the kakapo, a parrot from New Zealand, is one of the longest-lived birds on Earth.

Kakapos come out at night, waddling across the forest floor in search of fruit and nuts. Having opted for life on the ground, they have no need to stay light. Instead, their bones are filled with marrow and they can store large amounts of body fat. Despite appearances, they are expert tree climbers, and their stubby wings help them flap their way back down to the ground.

Everything about a kakapo's life moves slowly. They do not run from danger, but instead stand very still, relying on the moss-like camouflage of their feathers to remain undetected. Males do not start breeding until four years old, females at six, and they breed more slowly than any other bird. Mating only takes place every two to four years or so, when the rimu tree, and other conifers like the rimu, produce a bumper crop of fruit, providing the kakapos with the vital vitamins they need in order to reproduce.

The unhurried nature of the kakapo extends to the males' courtship. During the breeding season, a male will walk several kilometres to a special area, known as a lek, to compete for female attention. Each male digs a shallow bowl in the ground, then spends up to eight hours a night making loud booming calls. This can last for up to four months. If a female is interested, she approaches the bowl along tracks the male has cleared.



But all the features that make kakapos so unusual and so charming, are now their downfall. They evolved in a different world, free of mammals, when their only predator was an eagle, swooping down from the treetops. Their camouflage used to protect them, but with the arrival of humans to New Zealand around 800 years ago, along came rodents, cats and other mammals, and kakapo numbers plummeted.

By the 1970s, it was thought only a few males remained. Then scientists discovered a tiny population of breeding kakapos. They were taken to small, predator-free islands, and cared for under an intensive breeding programme. Today, there are just over 200 of these friendly birds left, slowly clawing their way back from the brink of extinction.

# AFRICAN ELEPHANT

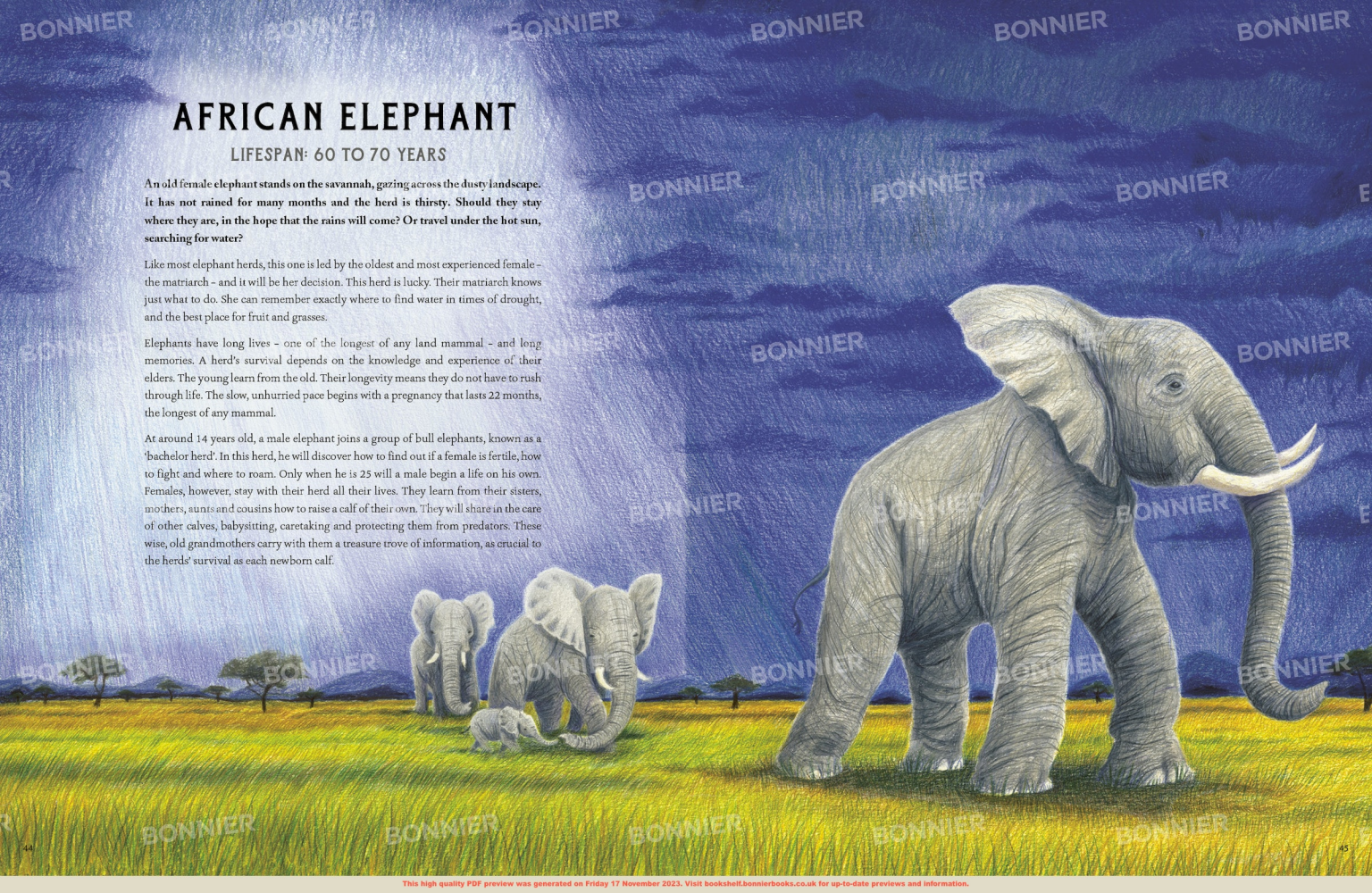
LIFESPAN: 60 TO 70 YEARS

An old female elephant stands on the savannah, gazing across the dusty landscape. It has not rained for many months and the herd is thirsty. Should they stay where they are, in the hope that the rains will come? Or travel under the hot sun, searching for water?

Like most elephant herds, this one is led by the oldest and most experienced female - the matriarch - and it will be her decision. This herd is lucky. Their matriarch knows just what to do. She can remember exactly where to find water in times of drought, and the best place for fruit and grasses.

Elephants have long lives - one of the longest of any land mammal - and long memories. A herd's survival depends on the knowledge and experience of their elders. The young learn from the old. Their longevity means they do not have to rush through life. The slow, unhurried pace begins with a pregnancy that lasts 22 months, the longest of any mammal.

At around 14 years old, a male elephant joins a group of bull elephants, known as a 'bachelor herd'. In this herd, he will discover how to find out if a female is fertile, how to fight and where to roam. Only when he is 25 will a male begin a life on his own. Females, however, stay with their herd all their lives. They learn from their sisters, mothers, aunts and cousins how to raise a calf of their own. They will share in the care of other calves, babysitting, caretaking and protecting them from predators. These wise, old grandmothers carry with them a treasure trove of information, as crucial to the herds' survival as each newborn calf.





# SALTWATER CROCODILE

LIFESPAN: 70 YEARS

There's something startlingly prehistoric about a saltwater crocodile. And that's not surprising, for they come from an ancient line of crocodylians dating back over 200 million years, and still look very similar to some of their armour-plated ancestors.

Today, the saltwater crocodile is the largest of its kind, and the largest reptile on Earth. It is also the longest-lived of any crocodile species, reaching 70 years or more.

'Salties', as they are known, are survivors: tough, robust and super predators.

Large adults can stay underwater for at least an hour, reducing their heart rates to 2-3 beats per minute. Camouflaged, with only their eyes and the tips of their noses above the surface, they remain motionless until prey comes close. Then they lunge with terrifying speed, grabbing their prey with one of the most powerful bites of any animal on Earth. They are also able to survive terrible injuries, such as a lost tail, jaw or limb.

But the key to their success as a species, and their ability to live for so long, comes from their cold-bloodedness. This means that crocodiles don't control their body temperature, in the way that mammals do. Instead, to maintain an ideal temperature, they move back and forth between warm and cool parts of their environment. This uses less energy, which means they need less food. Crocodiles can survive for over a year without eating.



There is much more, however, to a saltwater crocodile than a 'cold-blooded killer'. They are intelligent and able to adapt quickly to changes in their environment. They also make caring, attentive mothers. Females build nests out of mounds of mud and vegetation, so their eggs are kept safe and dry, and guard them closely.

When the baby crocodiles are ready to hatch, they call out to their mother. She uncovers the nest and carefully carries the hatchlings to the water in her mouth, up to 15 at a time. There she watches over them closely until they have learned to swim.

Only 1% of baby crocodiles make it to adulthood, most falling victim to fish, snakes and birds of prey. And it takes a long time for a saltwater crocodile to reach breeding age: 10-12 years for females, and 16 for males. But once a saltwater crocodile is fully grown, no animal, other than humans, can harm it.

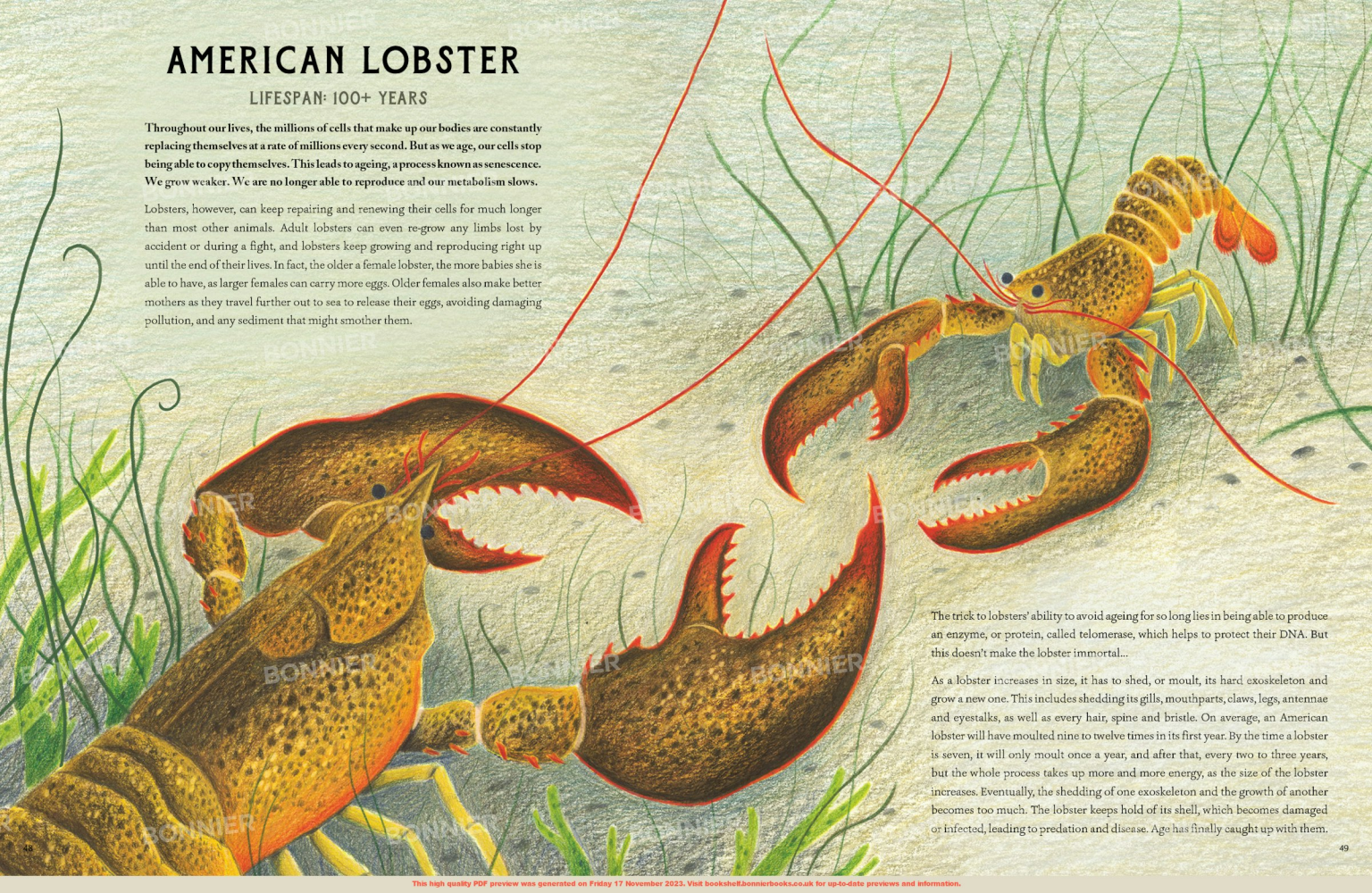


# AMERICAN LOBSTER

LIFESPAN: 100+ YEARS

Throughout our lives, the millions of cells that make up our bodies are constantly replacing themselves at a rate of millions every second. But as we age, our cells stop being able to copy themselves. This leads to ageing, a process known as senescence. We grow weaker. We are no longer able to reproduce and our metabolism slows.

Lobsters, however, can keep repairing and renewing their cells for much longer than most other animals. Adult lobsters can even re-grow any limbs lost by accident or during a fight, and lobsters keep growing and reproducing right up until the end of their lives. In fact, the older a female lobster, the more babies she is able to have, as larger females can carry more eggs. Older females also make better mothers as they travel further out to sea to release their eggs, avoiding damaging pollution, and any sediment that might smother them.



The trick to lobsters' ability to avoid ageing for so long lies in being able to produce an enzyme, or protein, called telomerase, which helps to protect their DNA. But this doesn't make the lobster immortal...

As a lobster increases in size, it has to shed, or moult, its hard exoskeleton and grow a new one. This includes shedding its gills, mouthparts, claws, legs, antennae and eyestalks, as well as every hair, spine and bristle. On average, an American lobster will have moulted nine to twelve times in its first year. By the time a lobster is seven, it will only moult once a year, and after that, every two to three years, but the whole process takes up more and more energy, as the size of the lobster increases. Eventually, the shedding of one exoskeleton and the growth of another becomes too much. The lobster keeps hold of its shell, which becomes damaged or infected, leading to predation and disease. Age has finally caught up with them.

# ORANGE ROUGHY

LIFESPAN: 100 YEARS

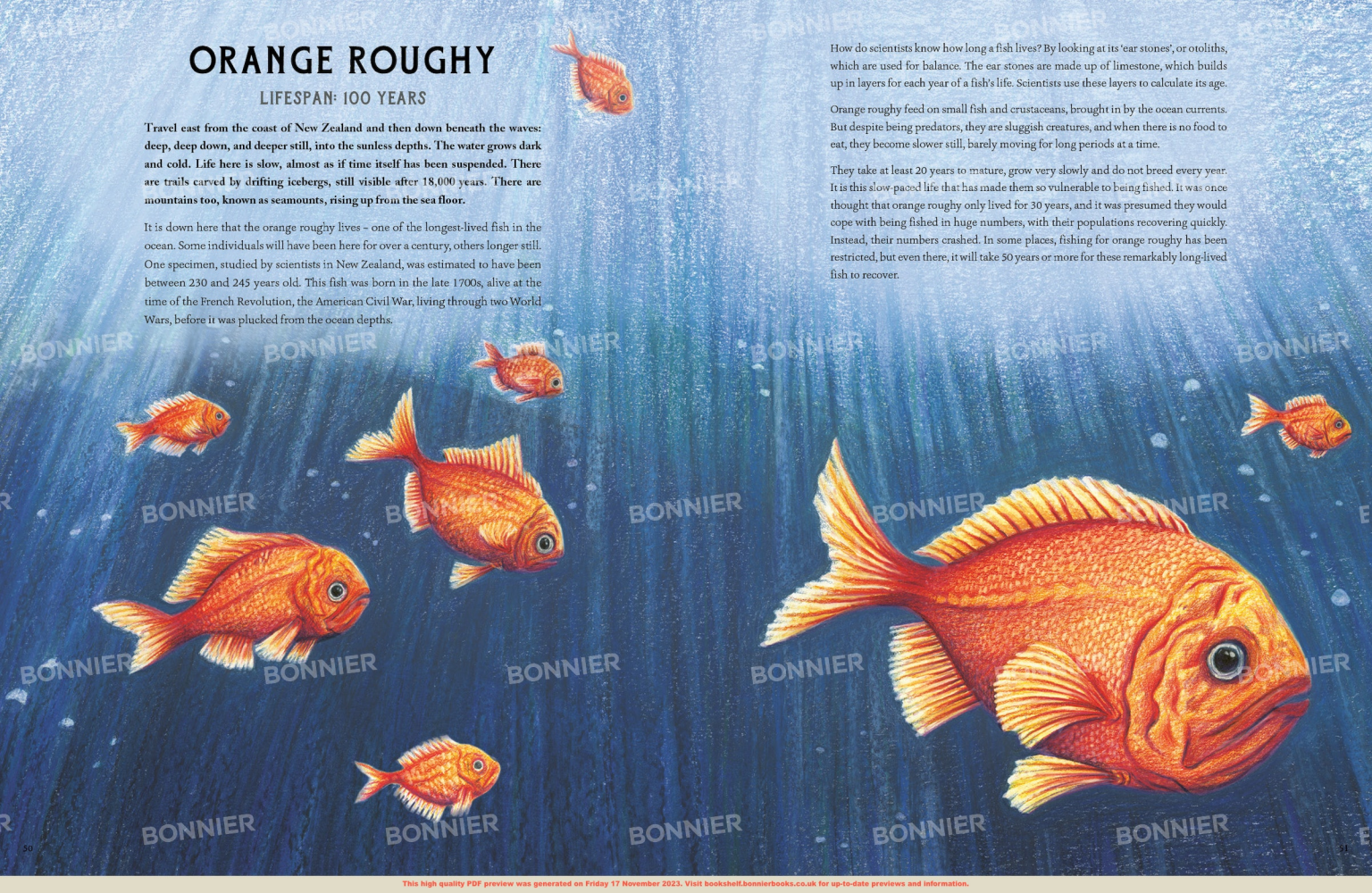
Travel east from the coast of New Zealand and then down beneath the waves: deep, deep down, and deeper still, into the sunless depths. The water grows dark and cold. Life here is slow, almost as if time itself has been suspended. There are trails carved by drifting icebergs, still visible after 18,000 years. There are mountains too, known as seamounts, rising up from the sea floor.

It is down here that the orange roughy lives – one of the longest-lived fish in the ocean. Some individuals will have been here for over a century, others longer still. One specimen, studied by scientists in New Zealand, was estimated to have been between 230 and 245 years old. This fish was born in the late 1700s, alive at the time of the French Revolution, the American Civil War, living through two World Wars, before it was plucked from the ocean depths.

How do scientists know how long a fish lives? By looking at its 'ear stones', or otoliths, which are used for balance. The ear stones are made up of limestone, which builds up in layers for each year of a fish's life. Scientists use these layers to calculate its age.

Orange roughy feed on small fish and crustaceans, brought in by the ocean currents. But despite being predators, they are sluggish creatures, and when there is no food to eat, they become slower still, barely moving for long periods at a time.

They take at least 20 years to mature, grow very slowly and do not breed every year. It is this slow-paced life that has made them so vulnerable to being fished. It was once thought that orange roughy only lived for 30 years, and it was presumed they would cope with being fished in huge numbers, with their populations recovering quickly. Instead, their numbers crashed. In some places, fishing for orange roughy has been restricted, but even there, it will take 50 years or more for these remarkably long-lived fish to recover.



# GALÁPAGOS GIANT TORTOISE

LIFESPAN: 100+ YEARS

A thousand kilometres off the coast of Ecuador, lie the Galápagos Islands. Here, amid rocks and cacti and pounding waves, roam giant tortoises, the largest of all tortoise species. They live for over a hundred years, and are found nowhere else on Earth.

But how did they get there? Scientists think that between two to three million years ago, some giant tortoises drifted out to sea, either by themselves or on mats of vegetation, until they came to land on these far-flung islands.

For two to three million years, the giant tortoises lived slow, peaceful lives in isolation. There were no predators for adult tortoises to fear, and no prey to catch. They spent their time munching on cacti, grasses and fruit. In the cooler months, they would sleep in the morning and the afternoon, only stirring into action around midday. In the hot season, they sought shade under the fierce midday sun, or cooled off by wallowing in muddy pools. When food and water was scarce, they slept, often for weeks at a time. The environment was tough, but the tortoises were perfectly adapted to it, able to last up to a year without food or water.



But then, in the 19th century, sailors discovered the tortoises were an excellent source of fresh meat so kept them on board their ships. The tortoises' ability to survive long periods without food or water now counted against them. By 1959, most of the giant tortoise populations on each island were endangered, or on the brink of extinction.

One of those was the Pinta Island tortoise. In 1971, there was just one its kind left, a male known as Lonesome George. Scientists searched his island, desperately hoping to find him a mate to save the species - but with no success. Lonesome George lived for a further 40 years, gaining worldwide fame, but no offspring.

All is not lost, however. In February 2019, a female Fernandina tortoise, a species not seen for 110 years, was found alive and well on her lava-flooded island. She was taken to a breeding centre and the hunt is now on to find her a mate. Scientists are hopeful, having found tracks and faeces which they believe belong to another Fernandina tortoise. With time and science on their side, there's hope for these giant tortoises yet.

# BOWHEAD WHALE

LIFESPAN: 200 YEARS

In 2007, newspaper headlines announced an amazing discovery: a bowhead whale had been found off the coast of Alaska, with a 130 year-old harpoon lodged in her shoulder. The arrow fragment, a leftover from a failed hunt, was dated to around 1880, suggesting that the whale had been swimming through Arctic waters since Victorian times. Here was evidence that bowhead whales are the oldest-living mammals on Earth. As the Innuits have long said, these whales live at least 'two human lifetimes'.

Further research, published in 2019, which used a genetic 'clock' to predict these animals' lifespans, revealed something even more incredible: that a bowhead whale has an average age of 268 years.



These animals are gargantuan in size, reaching 20m in length, and weighing up to 100t. Despite their great bulk, they feed on some of the smallest creatures in the ocean – zooplankton. The whales swim slowly with their mouths open, taking huge mouthfuls of sea water and then filtering out the plankton using the bristly baleen plates that hang from their upper jaw. Bowheads have massive heads too – up to a third of their entire body length – which they use to smash through the sea ice in order to come up to the surface to breathe.

Larger animals do tend to live longer than smaller animals, but it isn't size alone that give bowheads their amazing longevity. These whales far outlive blue and fin whales, which are bigger still. Scientists think the key is the bowhead's Arctic environment. The freezing waters means that bowheads have a low body temperature, which in turn means a slow metabolism, which causes less damage to their tissues.

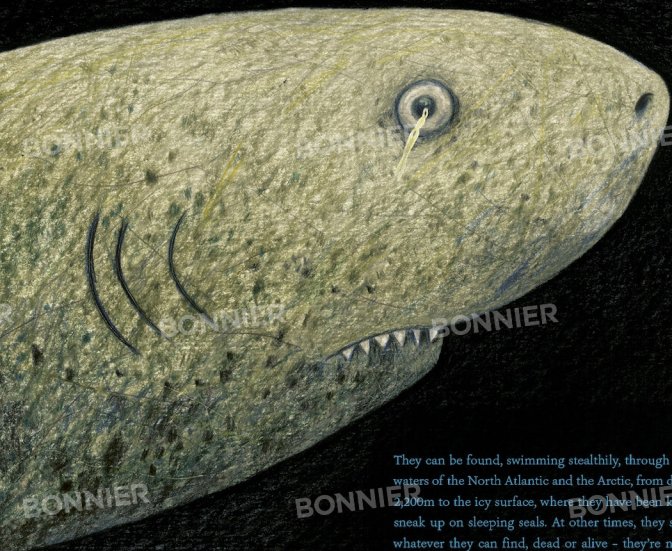
Once hunted nearly to the point of extinction, bowheads' numbers have started to increase since whaling was banned. It is thrilling to think that these ancient giants, some of whom have been alive since before the Victorian era, since 25 years before the USA existed, are still slowly swimming through the cold, dark waters of the Arctic.

# BONNIER BONNIER BONNIER

## GREENLAND SHARK

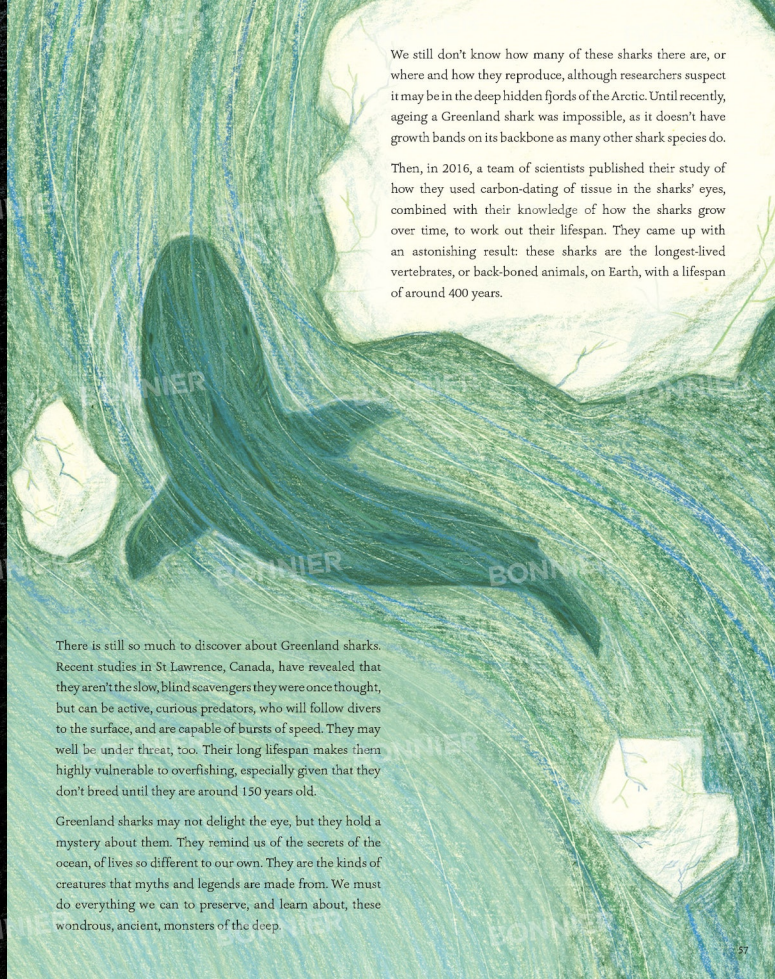
LIFESPAN: UP TO 500 YEARS

Greenland sharks are not immediately appealing. They are huge – about the length of a large car – with squat-shaped bodies, stunted fins, toxic skin, blunt snouts and gaping mouths. Many have wormlike parasites dangling from the fronts of their eyes.



They can be found, swimming stealthily, through the cold waters of the North Atlantic and the Arctic, from depths of 2,000m to the icy surface, where they have been known to sneak up on sleeping seals. At other times, they scavenge whatever they can find, dead or alive – they're not fussy. Individuals have been discovered with the remains of polar bears, reindeer and even horses in their digestive systems.

Aside from their bizarre eating habits, very little else is known about Greenland sharks. The deep, dark freezing waters they favour are so inhospitable to humans that the first video of a live shark was only recorded in 2003.



We still don't know how many of these sharks there are, or where and how they reproduce, although researchers suspect it may be in the deep hidden fjords of the Arctic. Until recently, ageing a Greenland shark was impossible, as it doesn't have growth bands on its backbone as many other shark species do.

Then, in 2016, a team of scientists published their study of how they used carbon-dating of tissue in the sharks' eyes, combined with their knowledge of how the sharks grow over time, to work out their lifespan. They came up with an astonishing result: these sharks are the longest-lived vertebrates, or back-boned animals, on Earth, with a lifespan of around 400 years.

There is still so much to discover about Greenland sharks. Recent studies in St Lawrence, Canada, have revealed that they aren't the slow, blind scavengers they were once thought, but can be active, curious predators, who will follow divers to the surface, and are capable of bursts of speed. They may well be under threat, too. Their long lifespan makes them highly vulnerable to overfishing, especially given that they don't breed until they are around 150 years old.

Greenland sharks may not delight the eye, but they hold a mystery about them. They remind us of the secrets of the ocean, of lives so different to our own. They are the kinds of creatures that myths and legends are made from. We must do everything we can to preserve, and learn about, these wondrous, ancient, monsters of the deep.

# OCEAN QUAHOG

LIFESPAN: 400 YEARS

The ocean quahog, a type of clam, doesn't look like much. A tiny, soft-bodied animal, with a hinged protective shell, that can fit in the palm of your hand. But this clam has a secret superpower...

It lives an unassuming life, buried in the seabed of the North Atlantic, filtering out food from the water with a long, tube-like structure, known as a siphon. Sometimes the siphon is all you can see above the seabed, and every so often its end is nibbled off by hungry fish.

Every year, these quahogs release sperm and eggs into the water, which are then fertilised. The larvae drift in the water for 30 days, until they develop into juveniles and settle to the bottom. There they begin to grow, very, very slowly.



But not everything is as it seems. For this tiny, seemingly insignificant animal can outlive almost any other: It can last for centuries. One ocean quahog, dredged up for study, was found to be 507 years old. Known as 'Ming', as it would have been alive during the Chinese Ming Dynasty, scientists were able to calculate its age by counting the number of bands on its shell.

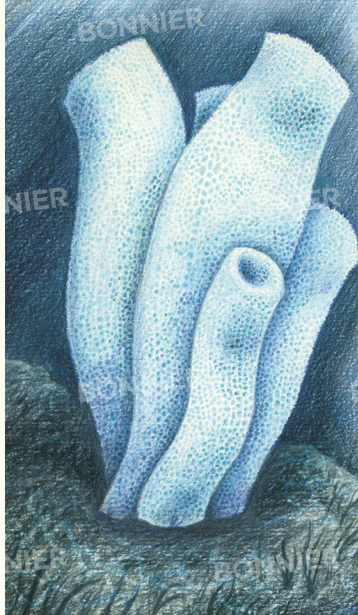
Just as amazingly, these tiny creatures can also reveal the secrets of our past. By looking at the quahogs' shells, scientists can study changes in the ocean over the centuries, from how warm the seas were, to how salty, and begin to understand what were once the natural rhythms of our climate, now masked by human activity. These ancient treasures are more than just molluscs. They are a window into another world.

# GLASS SPONGE

LIFESPAN: 11,000 YEARS

There are a few animals, all found in the deep sea, that can live even longer than the quahog. One of those is the deep-sea sponge, which may also have been one of the very first multicellular animals (organisms made of more than one cell) on Earth, first evolving more than 650 million years ago.

Individual sponges can live for thousands of years. One particular sponge, *Monorhaphis chuni*, found in the East China Sea, was estimated to be 11,000 years old. A type of glass sponge, it has a skeleton made of silica – a mineral found in glass. It can grow to nearly 3m tall with a single long, spectacular spine, just one centimetre thick, known as a spicule, which anchors it to the sea floor.



What is it about the deep sea that makes it home to so many long-lived creatures? At great depths, animals are protected from temperature changes and violent storms. These stable environments go hand-in-hand with longevity. Animals in shallower waters are also at greater risk of predation, so are less likely to evolve to be able to repair their bodies and achieve a healthy old age.

For deep-sea sponges that spend their lives fixed in one place, there is another advantage: sponges can break off into two or more individuals, each of which can regenerate into a new (but genetically identical) sponge. While many parts may die off, an individual will always be made up of some young pieces, which constantly replace the older ones.

It is an exciting time for deep-sea discoveries. Scientists are just beginning to find more of these long-lived species, and at the same time, they are starting to work out how they can reveal secrets about the distant past.

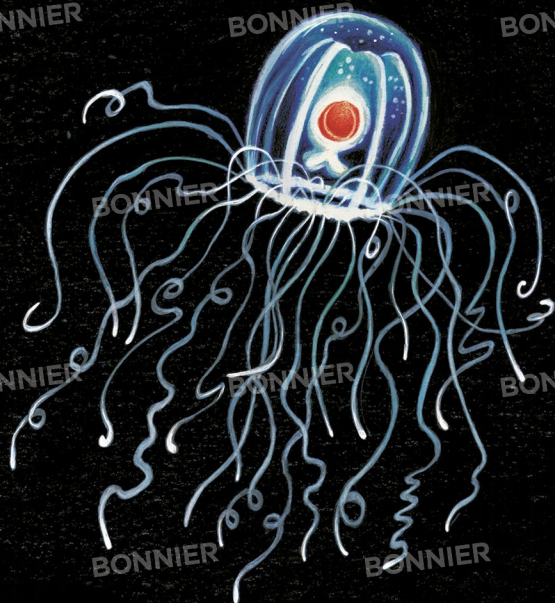
# IMMORTAL JELLYFISH

LIFESPAN: IMMORTAL

It's incredible to think of animals living for hundreds of years, like the Greenland shark in the freezing waters of the Arctic, or a thousand-year-old glass sponge, deep down at the bottom of the ocean. But it is even more amazing to imagine an animal that reaches the end of its life, only to begin all over again. No scientist thought it possible until the discovery, in the late 1980s, of a tiny jellyfish, no bigger than your little fingernail, that could do just that.

*Turritopsis dohrnii*, otherwise known as the immortal jellyfish, begins its life as a larva, a tiny creature that swims through the water, looking for something - a rock, a boat's hull - to attach itself to. There it develops into a tube-shaped polyp, with branching stalks, that end in little buds. It stays there for a while, growing into a colony of polyps. Then the buds at the ends of its stalks begin to swell, before sprouting into tiny baby jellyfish, with bell-shaped domes and dangling tentacles.

For most jellyfish, this stage - known as the medusa stage - is the final phase of its life. The medusa produces eggs or sperm, and then dies. But not the immortal jellyfish...



At any sign of threat, from starvation to physical danger, the jellyfish can transform itself back into a polyp, only for its life cycle to begin again - like a butterfly transforming back into a caterpillar, or a frog turning back into a tadpole. It can do this again, and again, and again.

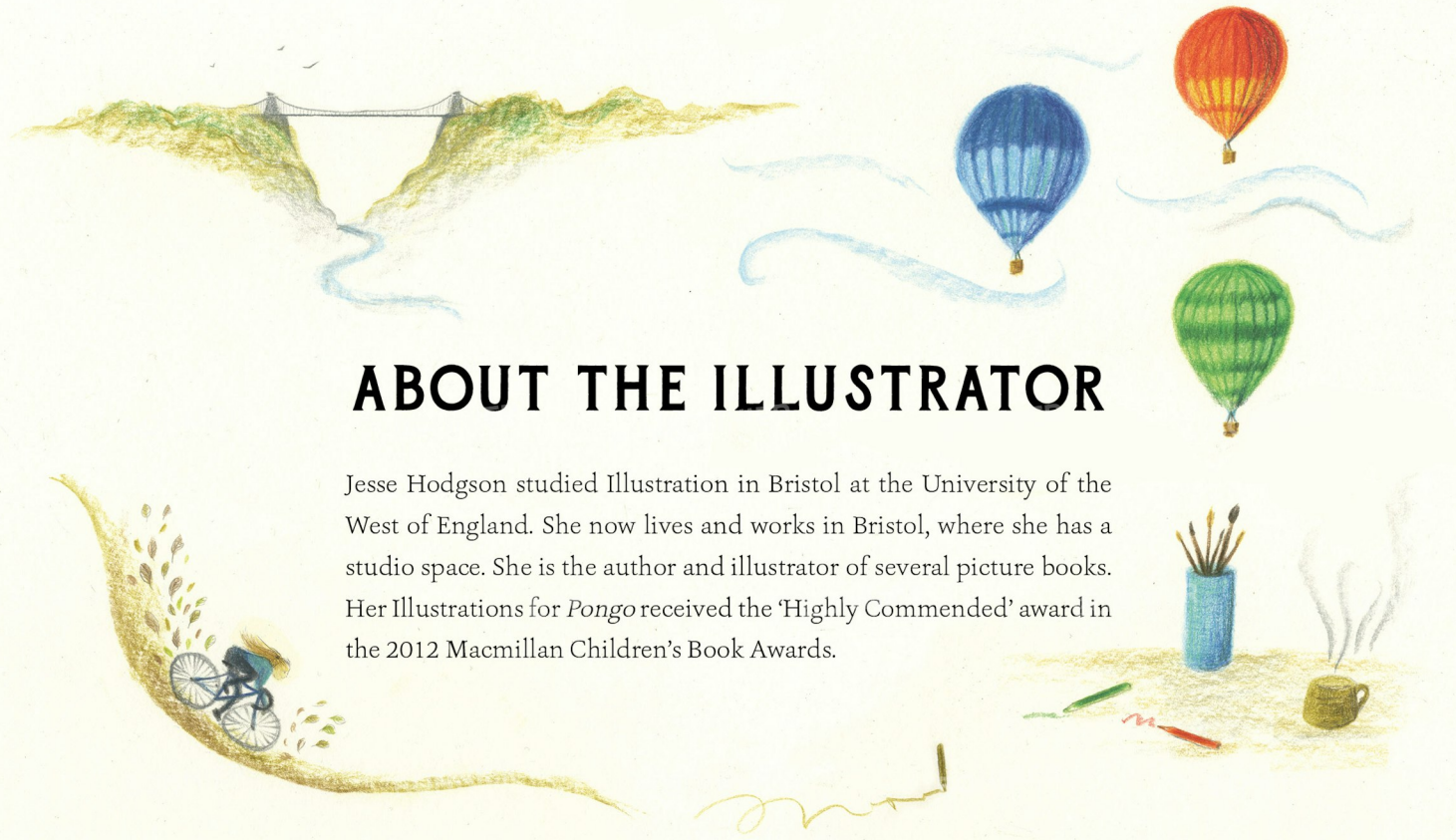
The immortal jellyfish, then, has escaped death. Although perhaps its immortality comes at a high price: it is, after all, a very simple creature, with no real brain, and just one opening for feeding and waste.

Some would argue that the jellyfish isn't truly immortal. It can still die by being eaten or from disease. Moreover, the cells that make up the new jellyfish are not the same as the old one. They have been changed in the regeneration process, so that the new jellyfish is a copy, a clone, rather than the exact same organism.

But something truly, breathtakingly remarkable is still happening here. Instead of death, this jellyfish becomes young again, in an endless cycle. It is one of the most rule-breaking discoveries of our time.







## ABOUT THE ILLUSTRATOR

Jesse Hodgson studied Illustration in Bristol at the University of the West of England. She now lives and works in Bristol, where she has a studio space. She is the author and illustrator of several picture books. Her illustrations for *Pongo* received the 'Highly Commended' award in the 2012 Macmillan Children's Book Awards.



## ABOUT THE AUTHOR

Lily Murray grew up in the wilds of snowy nowhere, spending much of her time talking to animals and making up stories. She has continued to do this in her adult life, and now writes both fiction and non-fiction books for children. Her titles include big books about dinosaurs, rhyming books about dinosaurs and stories about escapee hot dogs.