ocean conservation trust

Welcome to the Museum

Oceanarium

TEAGAN WHITE and LOVEDAY TRINICK

JUNIOR EDITION

BIG PICTURE PRESS

Oceanarium

Illustrated by TEAGAN WHITE

Written by LOVEDAY TRINICK

B P P

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The National Marine Aquarium is home to the Ocean Conservation Trust,
which aims to connect people with our ocean.

NMA NATIONAL MARINE AQUARIUM

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Entrance

Welcome to Oceanarium

This is no ordinary aquarium. Open twenty-four hours a day, seven days a week, it houses a whole host of amazing sea creatures. From weighty whales to microscopic sea sparkle, marvel at the kaleidoscope of colours, shapes and sizes of life under the water. Dive in to discover all the ocean has to offer.

Tour the aquarium, from the sunlit shallows to the darkest depths, and discover the extraordinary creatures that lie hidden beneath the waves. Take a moment to inspect each habitat carefully. Study the species that are nearly as old as life itself as they slowly patrol the open waters in search of their next meal. Keep an eye out for those whose scales glint and shimmer as they dart nervously between corals and be careful not to miss those lying perfectly still on the seabed.

Learn about our special connection with the ocean and how its future may well hold the key to our own future. What we do as humans has a huge impact on the natural world, and by understanding our complex relationship with the ocean we can work out how to overcome the many environmental challenges we currently face.

Enter *Oceanarium* and discover the secrets of the sea for yourself. From the wonderful to the weird, the fearsome to the vulnerable, this amazing world is ready for you to explore.

The Ocean

The ocean is the largest habitat on Earth. Its scale is hard to imagine: it contains 99 per cent of all the living space available to animals and plants on our planet! With an average of nearly four kilometres of water below the surface, diving beneath the waves reveals a world unseen by most people.

As you plunge below the ocean's surface, sunlight decreases with each metre. At the illuminated upper level – around 100 metres – a faint light can still be seen, enough for photosynthesis to take place. Seaweed and plankton flourish here and it's home to the majority of marine life.

Light disappears entirely at 200 metres as you enter the twilight zone. Venturing into the darkness, the pressure increases. Dive to 1,000 metres (the midnight zone) and the pressure is enough to crush most living things which live in shallower water. Even in this most extreme of environments, unique scuttling crabs and graceful jellyfish swarm around hydrothermal vents which provide precious sources of warm water and food.

At the deepest zone – the trenches – temperatures struggle to rise above freezing. Early explorers Don Walsh and Jacques Piccard proved life exists in these depths with their amazing journey into the Mariana Trench. Giant insect-like creatures could be found here scavenging for food fallen from the surface 11 kilometres away.

Ocean Zones

SUNLIGHT (0–200m)

TWILIGHT (200–1,000m)

MIDNIGHT (1,000–4,000m)

ABYSS (4,000–6,000m)

Herring gull (max diving depth 2m)

Bottlenose dolphin (max 50m)

Kelp (max 30m)

Great white shark (0–1,200m)

Sea nettle jellyfish (10–20m)

Atlantic hagfish (900–1,000m)

Bluntnose sixgill shark (max 2,500m)

Giant isopod (max 2,000m)

Tripod fish (max 4,700m)

Giant sea spider (max 4,900m)

Whale carcass

Cormorant (max diving depth 10m)

Humpback whale (max 200m)

Pacific herring (0–390m)

Indo-Pacific sailfish (max 200m)

Giant squid (300–1,000m)

Diving sperm whale (max 1,200m)

Dumbo octopus (3,000–4,000m)

Vampire squid (max 3,000m)

Humpback anglerfish (max 4,500m)

Sea pig (1,200–5,000m)

Mariana snailfish (6,000–8,000m)

Benthic comb jellyfish (max 7,200m)

Cusk eel (max 8,370m)

TRENCHES (6,000–11,000m)

OCEANARIUM

Gallery 1

Plankton

Phytoplankton

Zooplankton

Phytoplankton

The ocean is home to some of the smallest and biggest creatures that have ever lived. Among the smallest are plankton – microscopic organisms that drift through the sea, carried by the ocean currents and unable to swim against them. Plankton are so small that most are measured in micrometres (µm) – one centimetre is the equivalent of 10,000 micrometres.

Some plankton behave a little like plants and are known as phytoplankton. Phytoplankton can make their own food via photosynthesis. Because of this they are positioned at the bottom of the ocean food chain. They are vitally important because they support a whole ecosystem, providing food for many ocean animals, from tiny animal plankton to giant whale sharks.

With sunlight encouraging reproduction during the summer months, phytoplankton can occur in large numbers known as blooms. Too much phytoplankton can be damaging however, as harmful algae blooms can decrease oxygen levels and create 'dead zones' where marine animals and plants are unable to survive. This can be caused by fertiliser running off farmland and entering the sea which rapidly increases growth – a reminder that our activities on land can affect the sea.

Key to plate

1: **Dinoflagellate**
Diameter: Up to 200µm
During the day, this dinoflagellate extends its 'fingers' into the water. These contain chloroplasts which are used in photosynthesis.

2: **Cyanobacteria**
Diameter: Approx. 0.6µm
This minuscule plankton is one of the most abundant photosynthetic organisms on Earth. One millilitre of seawater can contain around 100,000 cyanobacteria.

3: **Coccolithophore**
Length: Up to 75µm
Coccolithophores are covered in chalky discs which reflect sunlight. When this phytoplankton blooms, the reflection is visible to satellites in space!

4: **Diatom**
Length: Up to 300µm
This diatom is a tiny, single-celled algae that makes its body out of glass-like silica – meaning it effectively lives in a glasshouse.

5: ***Chaetoceros debilis***
Length: Up to 20µm
These microscopic algae join together to form long, spiral-shaped chains.

6: **Sea sparkle**
Diameter: Up to 2,000µm
This species makes light via bioluminescence – a chemical reaction – when disturbed, producing an amazing blue-green glow.

Zooplankton

Some zooplankton are the larvae of animals, and will grow and eventually mature into crabs, fish and other sea creatures. Others, such as copepods, will remain tiny organisms their whole lives. Floating by the thousands in every drop of water on the ocean's surface, zooplankton and phytoplankton form a life-filled 'soup' which will ultimately feed almost every other animal in the ocean.

Both phytoplankton and zooplankton play an important role in ocean food chains. While phytoplankton use the sun's energy to make food, zooplankton provide the link between phytoplankton and larger sea creatures. Some are herbivores and graze directly on phytoplankton, while others are predators and hunt for smaller zooplankton. Many are eaten by larger animals. Amazingly, blue whales can consume as much as four tonnes of krill in a single day.

Despite their minute size, zooplankton travel from the ocean's surface to the murky depths and back again every day. This is called vertical migration and it allows them to feed on phytoplankton at the surface at night, avoiding predators that hunt there during the day. With so many of these animals completing a daily round trip of around 2,000 metres, it is one of the largest migration events on Earth.

Key to plate

1: **Sea butterfly**
Shell width: Up to 6mm
This tiny snail provides the main food source for a type of sea slug called the sea angel.

2: **Polychaete worm**
Length: Up to 50mm
There are 10,000 species of these marine worms, also known as sea mice and feather duster worms.

3: **Starfish larvae**
Length: Approx. 1mm
These larvae eventually get too heavy and sink to the seabed.

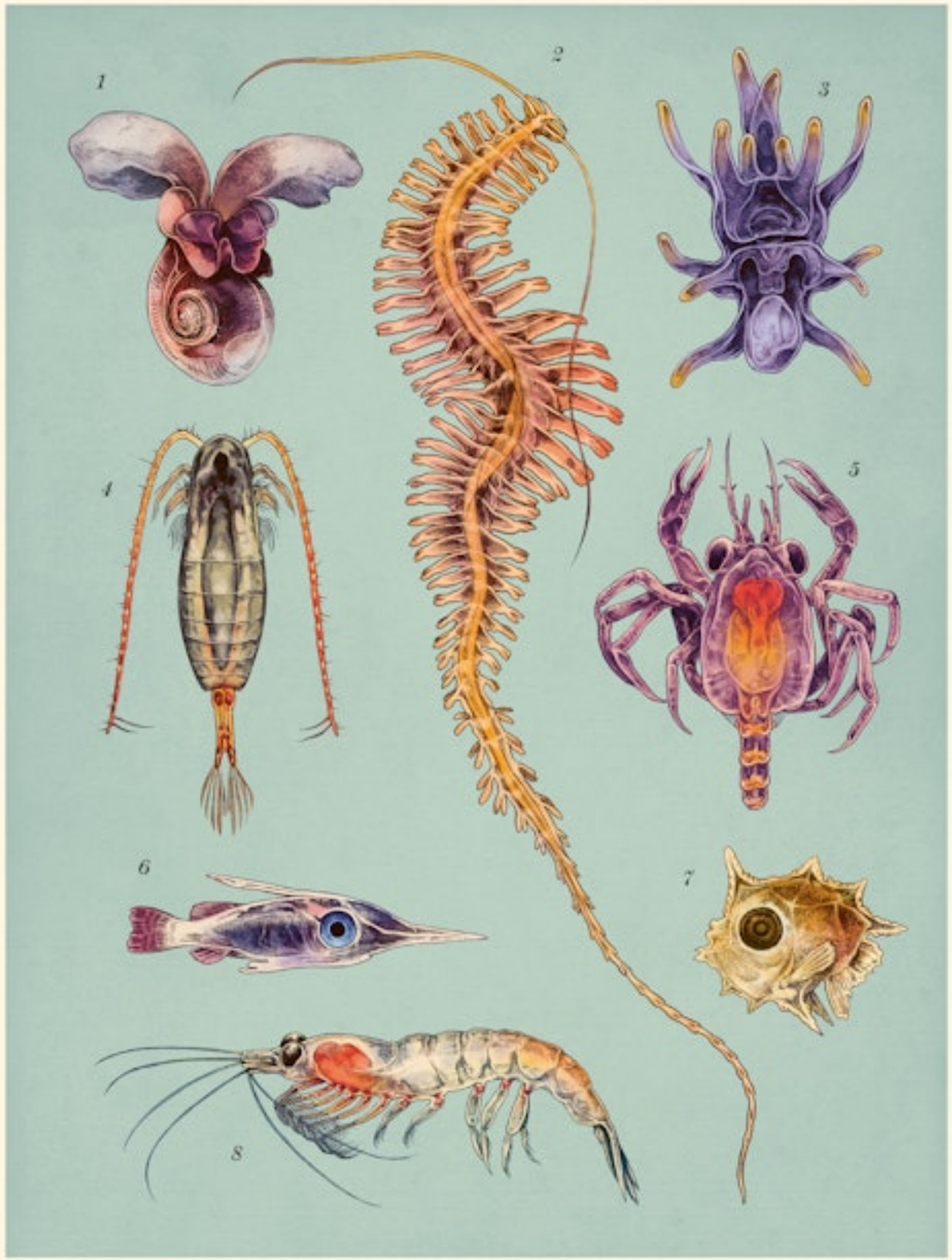
4: **Copepod**
Length: Up to 5.5mm
There are around 13,000 species of copepod.

5: **Green shore crab larvae**
Length: Up to 4mm
These larvae move in sync with the tides in order to reach deeper coastal waters.

6: **Swordfish larvae**
Length: 4mm
An adult swordfish can be 3m long and a fearsome predator.

7: **Sunfish larvae**
Length: Approx. 2mm
An adult sunfish can grow to nearly 2m, meaning there's a big size difference between larvae and adult. Huge, flat and circular, a sunfish looks a bit like a swimming head!

8: **Antarctic krill**
Length: Up to 6cm
By weight, krill are likely to be the most abundant animals on Earth.



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Gallery 2

Cnidaria

Jellyfish

Anemones

Habitat: Coral Reef

Jellyfish

Jellyfish wander the ocean, drifting with the currents wherever the water takes them. Despite their name, they are not fish but invertebrates as they don't have a skeleton. Their soft, bell-shaped bodies are around 95 per cent water and contain neither brain nor heart. They have limited movement but can push themselves gently through the water by filling their body (the bell) with water and squeezing it back out again.

Along with coral and anemones, jellyfish belong to the group Cnidaria. All cnidarians are carnivores and use stinging cells to catch prey and to defend themselves. Most jellyfish have long tentacles, which are lined with harpoon-like stings. When jellyfish dangle their tentacles into the water, the sting fires venom into the victim the moment they brush against it. Several species of jellyfish are translucent, meaning other animals will not see the danger ahead until it is too late, whereas others use bright colours to attract prey. For instance, flower hat jellyfish have fluorescent-tipped tentacles, which may look like green algae to unsuspecting fish. The fish approach the tentacles in the hope of food, but instead swim into a fatal trap. Incredibly, some young fish and crabs seek shelter in the tentacles. They rely on a thick mucus coating to protect them or nimbly dodge the tentacles as they sway in the water.

Key to plate

1: **Box jellyfish**
Bell diameter: Up to 35cm
Tentacle length: Up to 3m
Also known as the sea wasp, this species has deadly venom.

2: **Lion's mane jellyfish**
Bell diameter: Over 2m
Tentacle length: Up to 37m
This is the largest known species of jellyfish.

3: **Common kingslayer**
Bell diameter: 5mm
Tentacle length: Up to 100cm
The sting of this tiny box jellyfish can be fatal.

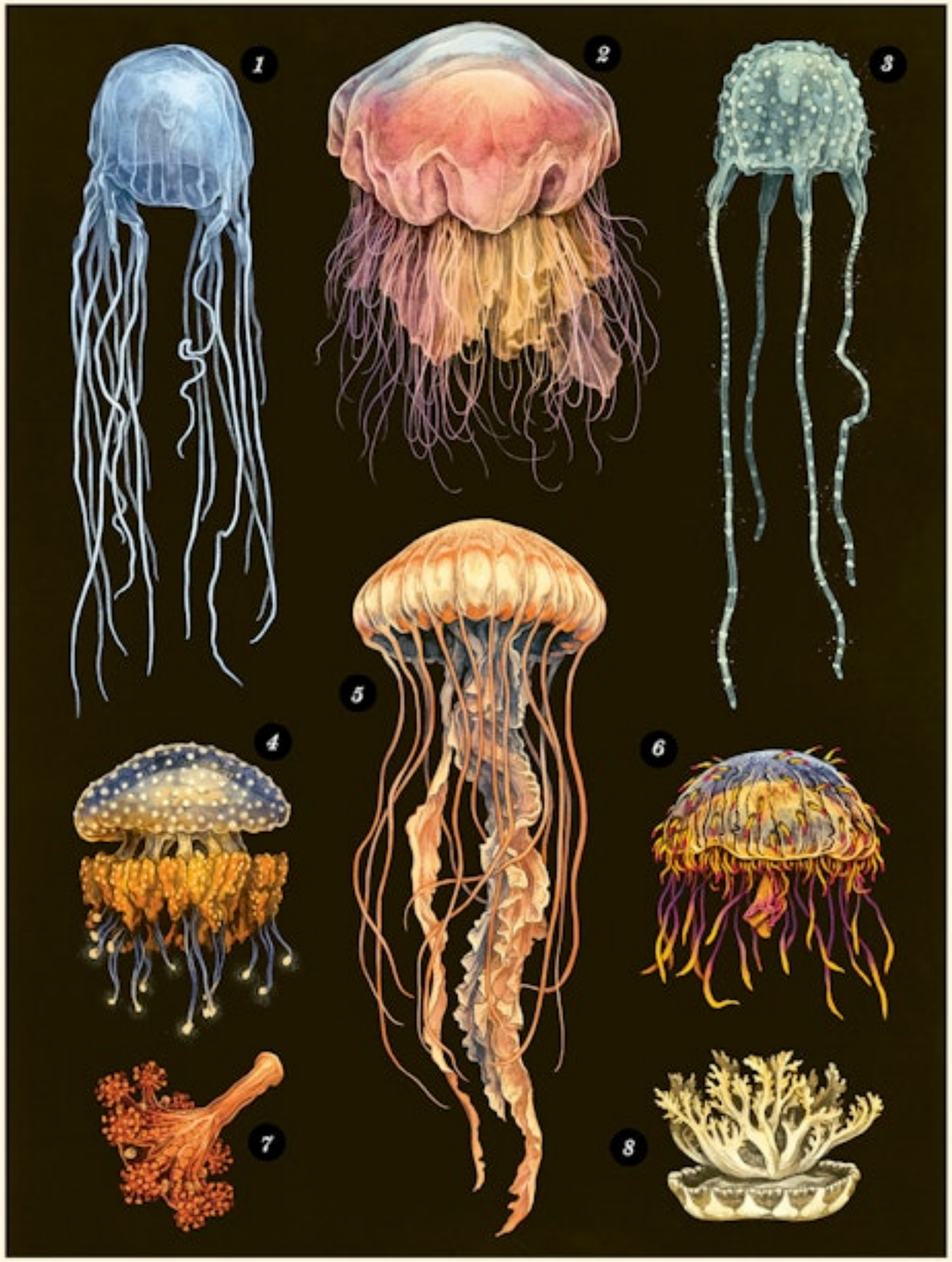
4: **White-spotted jellyfish**
Bell diameter: Up to 50cm
Tentacle length: Up to 1cm
This species are filter feeders.

5: **Pacific sea nettle**
Bell diameter: Up to 30cm
Tentacle length: Up to 4.5m
Sea nettles provide shelter for young fish and crabs.

6: **Flower hat jellyfish**
Bell diameter: Approx. 15cm
Tentacle length: Up to 12cm
This species lives near the seafloor and has tentacles all over its bell (body).

7: **Kaleidoscope jellyfish**
Height: Up to 2.5cm, including tentacles
This stalked jellyfish spends its whole life in one place, attached to seagrass or seaweed.

8: **Upside-down jellyfish**
Bell diameter: Up to 36cm
Tentacle length: Up to 26cm
This peculiar species sits upside down on the seabed with its tentacles waving above it.



Anemones

With around 1,000 known species worldwide, anemones can be found throughout the ocean, from shallow coastal areas to the deep sea, and even on the underside of Antarctic sea ice. These beautiful creatures spend most of their lives in one place, sticking to a suitable rock with a strong sticky foot. With their colourful tentacles, they look more like a plant than an animal.

Just like other members of the cnidaria family, anemones stretch out their colourful stinging tentacles in order to catch food. The strength of the sting varies, with some species able to catch and kill tiny plankton and others able to snare larger prey, such as fish. Some creatures, such as the clownfish find shelter from predators amongst the tentacles. In return, the anemone is kept clean and parasite-free by the family of clownfish. Relationships exist between anemones and other animals too. The pompom crab, for example, picks up and holds tiny anemones in its claws and carries them to new areas of the ocean that would otherwise be unreachable. The crab can then wave the anemones at predators to protect itself.

Key to plate

1: **Bubble-tip anemone**
Diameter: Up to 30cm
This beautiful anemone provides a home for clownfish. A thick layer of mucus protects the fish from stings.

2: **Hell's fire anemone**
Diameter: Up to 20cm
As the name suggests, this anemone can deliver a painful sting causing skin ulcers in humans.

3: **Jewel anemone**
Diameter: Up to 1cm
These tiny anemones group together and grow in large numbers.

4: **Snakelocks anemone**
Diameter: Up to 7cm
Microscopic algae called zooxanthellae live inside the tentacles of this species.

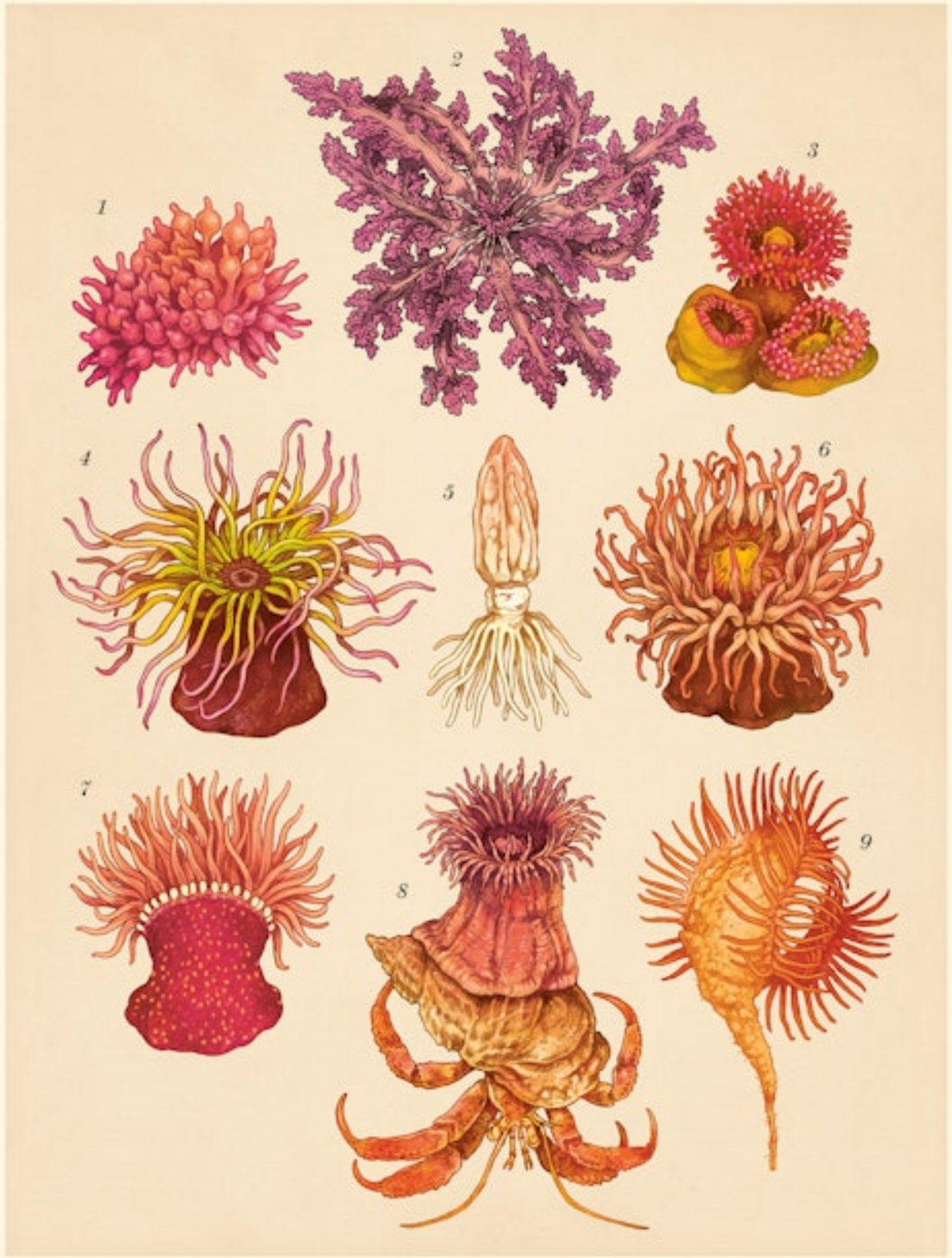
5: ***Edwardsiella andrillae***
Length: Up to 2.5cm
The only anemone to be found living in the ice of Antarctica, it was discovered by an underwater robot in 2010.

6: **Fish-eating anemone**
Diameter: Up to 25cm
Unlike most other anemones, this species can detach quite easily from rocks so can move to find food or if threatened.

7: **Strawberry anemone**
Diameter: Up to 10cm
This shore-dwelling anemone tucks its tentacles in when exposed to air.

8: **Parasitic anemone**
Diameter: Up to 5cm
Often found living on the shells of hermit crabs, parasitic anemones can grab a lift to new areas, while the crabs gain protection from the anemones' tentacles.

9: **Venus flytrap anemone**
Height: Up to 30cm
This deep-sea anemone uses its long stalk to turn and face the current so it can catch food.



Habitat: Coral Reef

Bustling with life, this habitat supports an incredible 25 per cent of marine life worldwide. The animals that live here seek shelter in the reef's nooks and crannies and feast on the food the colourful corridors provide.

Coral reefs are formed by coral polyps: tiny animals that resemble sea anemones and live in huge groups called colonies. When they die, the polyps leave behind their hard calcium carbonate, or limestone, skeletons and the reef gradually becomes bigger. Microscopic algae called zooxanthellae live inside the polyps and provide them with food using photosynthesis. Zooxanthellae also produce vivid pigments and so give coral reefs their wonderful bright colours.

Corals make enormous habitats such as the Belize Barrier Reef and the Great Barrier Reef in Australia. Visible from space, coral reefs are the largest living structures on our planet but they only grow under specific conditions, requiring temperatures of 20 to 32°C and shallow, sunlit waters. Climate change is therefore having a big effect. If sea temperatures rise, the zooxanthellae cannot survive, so they leave the polyps. The corals then lose their colour and most of their food, endangering the whole habitat.

Key to plate

Belize Barrier Reef, Central America

1: **Reef manta ray**
Width: Approx. 3.5m
This is the second largest species of ray in the world.

2: **Green turtle**
Length: Approx. 1.2m
This turtle takes its name from the colour of its fat, rather than the colour of its shell.

3: **Common bottlenose dolphin**
Length: Up to 4m
This species lives in groups called pods. They can contain up to 1,000 individuals.

4: **Blue chromis**
Length: Up to 15cm
These bright fish are normally found in big shoals.

5: **Staghorn coral**
Height: Up to 2m
This coral grows faster than most, adding 10–20cm a year.

6: **Spotted moray eel**
Length: Approx. 60cm
This solitary eel normally hides in the reef with only its head poking out.

7: **Table coral**
Diameter: Up to 2m
This coral grows in flat, table-like structures.

8: **Brain coral**
Diameter: Up to 2m
The maze-like grooves and folds protect the brain coral's polyps.

9: **Caesar grunt**
Length: Approx. 20cm
These fish make noises underwater by grinding their teeth together.

OCEANARIUM

Gallery 3

Molluscs and Echinoderms

Bivalves and Gastropods

Cephalopods

Echinoderms

Habitat: Deep Sea

Bivalves and Gastropods

Bivalves are a type of mollusc. Most have two hinged shells, which means they can completely enclose and protect themselves. They can survive some of the toughest habitats on Earth, including deep-sea hydrothermal vents which reach temperatures in excess of 300°C. Because they are attached to the seabed (usually via a tough stringy material called byssal thread), bivalves filter feed by using tiny hairs to catch passing plankton from the water. Bivalves create nacre which smooths the inside of their shells, protecting their soft bodies from harm. Nacre is more commonly known as 'pearl' or 'mother of pearl' and is the only jewel on Earth created by an animal. If a parasite makes its way inside a bivalve's shell, layers of nacre will gradually build up around it, forming a pearl.

Gastropods, generally known as slugs and snails, are the only type of mollusc that can live on land and in both saltwater and freshwater. Typically, snails have coiled shells which protect them from predators. Made from calcium carbonate, a material found in rocks, these shells are strong and durable. Sea slugs and the closely related sea hares have beautiful colours, patterns and sensory horns called rhinophores. Though they lack a shell, they are by no means defenceless. Some, such as the blue dragon, can eat animals too dangerous for others to tackle, stealing the venom from jellyfish for their own defence.

Key to plate

1: **Common cockle**
Length: Up to 5cm
Found on muddy and sandy shores, cockles are edible clams.

2: **Giant clam**
Length: Approx. 1.2m
Giant clams are the largest known species of bivalve.

3: **Queen scallop**
Length: Approx. 9cm
Scallops can swim – very slowly! – by opening and closing their shell.

4: **Blue dragon**
Length: Up to 3cm
This sea slug feeds on the stinging cells of the Portuguese man o' war.

5: **Pacific oyster**
Length: Approx. 18cm
Originating from Japan, these bivalves are a popular seafood.

6: **Common mussel**
Length: Up to 10cm
Growing in clumps, mussels attach themselves to rocks or each other.

7: **Violet sea snail**
Length: Up to 4cm
Floating from a raft of self-made bubbles, this small snail hangs upside down.

8: **Flame shell**
Length: Approx. 2.5cm
This bivalve's shell is always slightly open, ready to catch food.

Cephalopods

Cephalopods are molluscs and include octopuses, cuttlefish and squid. Cephalopods are soft-bodied animals, with strong muscles to control their multiple limbs, which they use to catch food and move things around their habitat. Despite their jelly-like appearance, they have a toughened beak in their mouths which is strong enough to pierce the shells of crabs and lobsters – their preferred prey.

Many of these animals also possess a toxin which paralyses their victim, allowing them to be eaten safely. In some species, such as the blue-ringed octopus, one bite has enough venom to kill several humans.

While all cephalopods are intelligent, octopuses are particularly smart and research has proven that they are able to problem-solve and remember solutions. Helped by their lack of bones, they can squeeze their whole bodies through the tiniest of spaces to evade danger. Their skin also contains colour-changing pigment cells which allow them to camouflage with their environment. If none of these defences work, octopuses can produce a dark cloud of ink, which can act as a decoy and allow for a quick getaway.

Key to plate

1: **Hummingbird bobtail squid**
Mantle length: Up to 5cm
This tiny squid has a beautiful glow thanks to the bioluminescent bacteria that live in its mantle.

2: **Dumbo octopus**
Mantle length: Unknown
This is one of the deepest-living octopuses we know of, and it is incredibly rare.

3: **Flamboyant cuttlefish**
Mantle length: Approx. 6cm
This cuttlefish doesn't swim as much as other species, but crawls along the ocean floor instead.

4: **Knobbed argonaut**
Length: Up to 3cm (males), 30cm (females)
These fragile-looking animals are known as 'paper nautiluses' but are in fact octopuses. The females secrete a paper-thin shell to live in and to hold their eggs while they grow.

5: **Giant Pacific octopus**
Mantle length: Up to 60cm
The largest known species of octopus, this giant can weigh around 60kg.

6: **Chambered nautilus**
Mantle length: Up to 20cm
The nautilus is known as a 'living fossil' because it has changed very little over millions of years.

7: **Humboldt squid**
Mantle length: Approx. 1.5m
This species is also known as the red devil due to its bioluminescent light.

8: **Greater blue-ringed octopus**
Mantle length: Up to 4cm
The blue rings on this tiny octopus flash brightly when approached, warning of a deadly bite.

Echinoderms

Found in every part of the ocean, from the shallows to the deep sea, echinoderms include starfish, sea cucumbers, sea urchins and sand dollars. They either creep slowly over the seabed or are anchored in one place, gently sifting food out of the water. They may appear defenceless and unable to chase prey, but they are full of surprises and are in fact amazing predators.

With a name meaning 'spiny skin', echinoderms usually have a covering of tough spines which helps to protect them from predators. Sucker-like feet also cover their undersides. Known as tube feet, these help echinoderms to stick to, or crawl along, the seabed and grab hold of food. Tube feet can smell and taste the water around them, helping to lead echinoderms towards food and away from predators.

This group has other clever ways of defending themselves too. Some, like the sea cucumber, eject their digestive system, leaving it behind as a decoy. Incredibly, echinoderms can also regrow body parts lost to predators, and starfish can regenerate whole limbs. Just a single arm can regrow into a complete animal because it contains everything a starfish needs to survive.

Key to plate

1: **Crown-of-thorns starfish**
Diameter: Up to 35cm
These spiny-looking starfish have up to 21 arms.

2: **Sea pig**
Length: Up to 15cm
These sea cucumbers move along the ocean floor using long, tube-like limbs.

3: **Red slate pencil urchin**
Diameter: Up to 8cm
Sea urchins use the five tough plates in their mouth to scrape algae off rocks. This species' spines were once used as writing utensils for slate boards.

4: **Crimson knobbed starfish**
Diameter: Up to 30cm
An impressive predator, this starfish eats clams, oysters and mussels as well as other starfish.

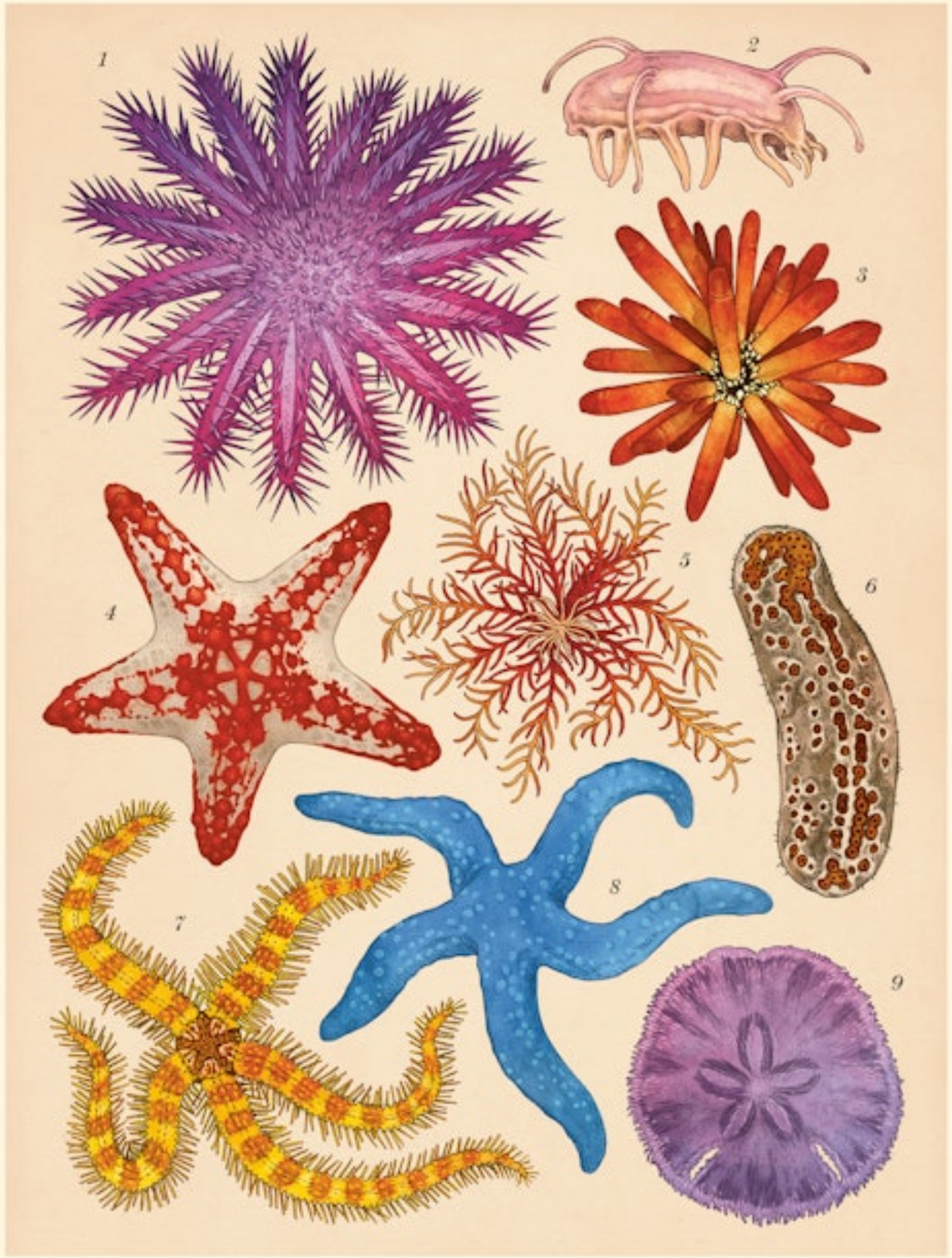
5: **Rosy feather star**
Diameter: Up to 20cm
Feather stars spend most of their time anchored to the seabed. Their feather-like arms catch plankton from the passing water.

6: **Leopard sea cucumber**
Length: Up to 60cm
Sea cucumbers munch through the seabed, digesting any food they find.

7: **Spiny brittle star**
Diameter: Up to 12cm
These brittle stars tend to be small but occur in large numbers.

8: **Blue starfish**
Diameter: Up to 30cm
These starfish live in the shallow waters of coral reefs or seagrass beds.

9: **Eccentric sand dollar**
Diameter: Approx. 8cm
Sand dollars are flat, burrowing sea urchins. Covered in small spines, they filter feed with food passing from spine to spine until it reaches the mouth.



Habitat: Deep Sea

The deep sea is constantly dark and cold, and the pressure is strong enough to crush most creatures. For a long time, because of these conditions, people thought there was no life in the ocean's depths. With the use of underwater vehicles, however, scientists have discovered fascinating species whose features and behaviours mean they are able to cope with such a hostile environment.

Because no light reaches the seafloor, no plants or algae can grow, which means herbivores can't survive. The only way to feed is by scavenging, hunting or sieving tiny particles of food from the water. Hunting can be a challenge in the dark waters but many animals get around this by making their own light, a feature called bioluminescence. This is either made by chemicals inside their bodies or via bacteria that live on them. Though bioluminescence can allow predators to see in the dark, it often proves more useful in attracting smaller fish towards hungry mouths. Other animals use light to communicate, flashing messages to each other through the gloom.

Key to plate

Abyssal plain, Atlantic Ocean

1: **Atolla jellyfish**
Bell diameter: Up to 17cm
Also known as the 'alarm' jellyfish, the atolla flashes blue when attacked.

2: **Common northern comb jelly**
Length: Up to 15cm
This jellyfish hunts tiny zooplankton.

3: **Black dragonfish**
Length: Approx. 40cm (females), 5cm (males)
This fish makes red bioluminescence. As most deep-sea animals can't see red, the dragonfish can go unseen.

4: **Bluntnose sixgill shark**
Length: Approx. 3m
Most sharks have five gills, but this large species has six.

5: **Humpback anglerfish**
Length: Approx. 18cm (females), 3cm (males)
The females of this species have a bright 'lure' to attract prey.

6: **Bone-eating snot flower worm**
Length: Up to 2cm
Female worms bore into whale bones to eat the marrow inside.

7: **Atlantic hagfish**
Length: Approx. 40cm
This monster scavenger bores its way into its victim, then eats its way out!

8: **Giant isopod**
Length: Up to 36cm
This crustacean has 14 legs and is related to the tiny woodlouse.

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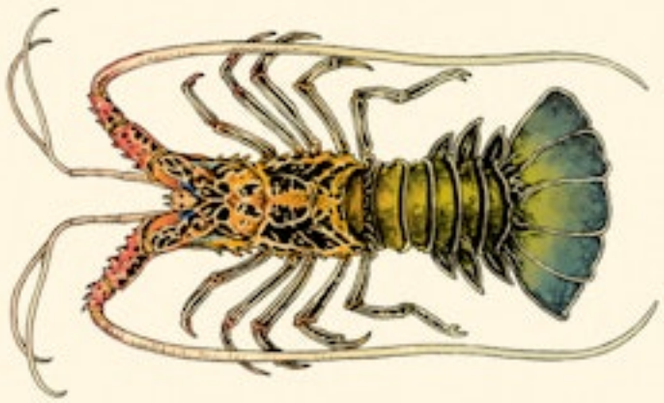
Gallery 4

Crustaceans



Crustaceans

Habitat: Rock Pool

Crustaceans

Crustaceans are members of a group called arthropods, which include insects and arachnids. They account for around 80 per cent of all living creatures.

Most crustaceans have a tough, shell-like armour called an exoskeleton which protects them from predators. For crustaceans to be able to grow, however, the exoskeleton must be shed. This can take several weeks so the soft and vulnerable crustaceans must hide or bury themselves until their new shell has hardened.

Another common feature of crustaceans is their five pairs of jointed legs, with the front pair forming pincers in some species. The pairs of limbs are used for different things; some are used for walking and swimming, others for catching and cutting food, and some for sensing the environment. Crustaceans can 'taste' with their feet and detect chemicals from other animals in the water. It's because of their amazing senses that crustaceans can survive in every type of ocean.

While most crustaceans can move around, barnacles stay still. Firmly attached to the rocks, they can open tiny doors in their shell-like home, allowing them to feed on passing plankton.

Key to plate

1: **Painted spiny lobster**
Length: Approx. 30cm
These beautiful lobsters are nocturnal and live alone in small caves and crevices in coral reefs.

2: **Acorn barnacle**
Diameter: Up to 15mm
This barnacle spends its whole life cemented to a rock.

3: **Norway lobster**
Length: Up to 20cm
The tail of this small lobster is known as scampi when it's eaten.

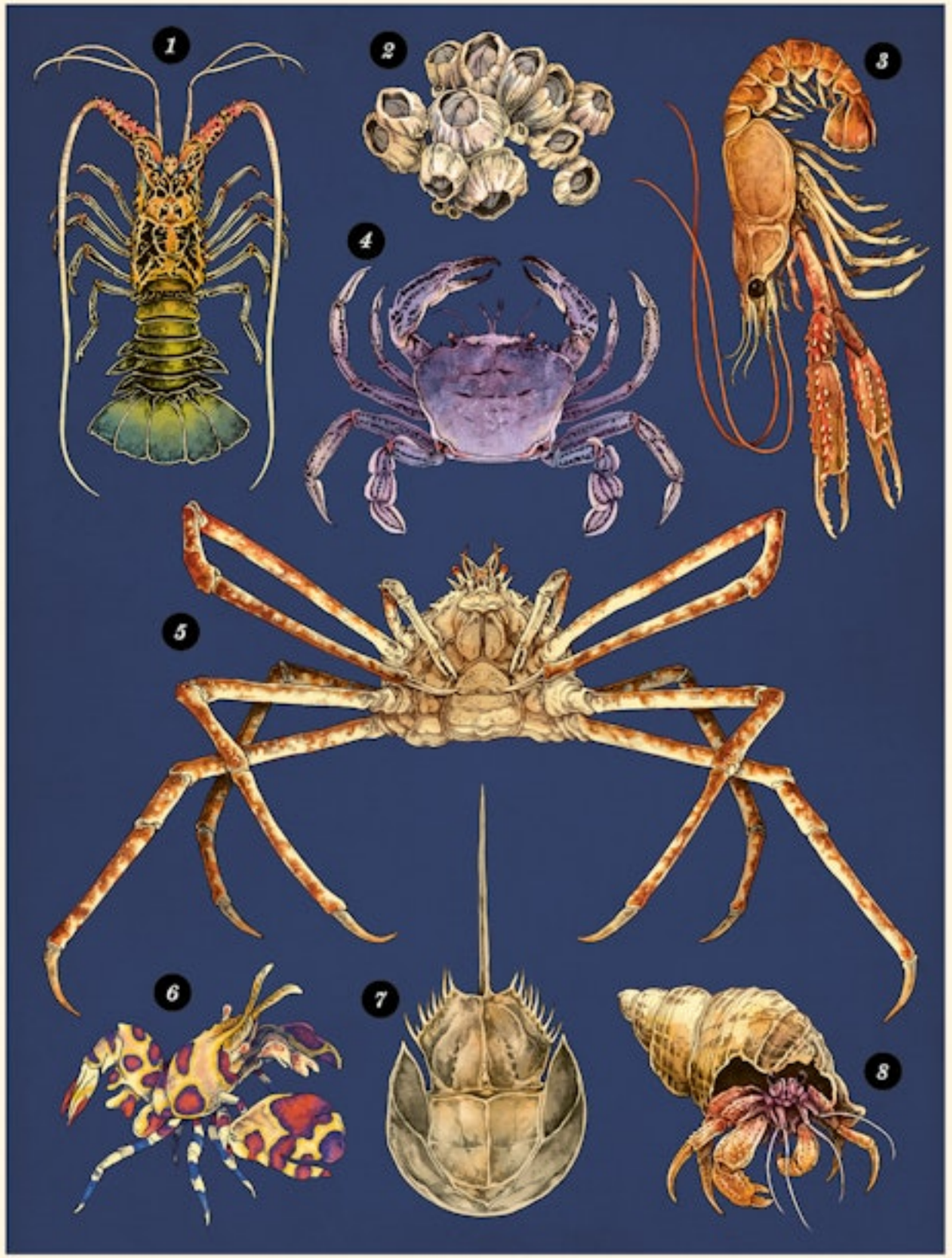
4: **Velvet swimming crab**
Carapace width: Up to 10cm
These crabs have red eyes, giving them the nickname 'devil crab'.

5: **Japanese spider crab**
Carapace width: 40cm
The long legs of this crab can grow up to 4m. They often break, but can be regrown.

6: **Harlequin shrimp**
Length: Up to 5cm
Members of this species work together to hunt and feed on starfish.

7: **Indo-Pacific horseshoe crab**
Length: Up to 50cm
Horseshoe crab blood is bright blue. Their blood is used in human vaccine trials because it is very sensitive to bacteria.

8: **Common hermit crab**
Carapace length: Approx. 3.5cm
These crabs have no exoskeleton on the rear half of their bodies. They search the ocean floor looking for empty shells, and once they are sure the shell has no owner, they move in.



Habitat: Rock Pool

Rock pools are the small pockets of seawater left behind in the rocky holes of the shoreline at low tide. A very changeable habitat, nothing stays the same for long in a rock pool. Wildlife has to deal with varying temperatures and differing amounts of oxygen and space depending on who they are sharing the rock pool with.

Tides are the rise and fall of the planet's ocean. They are caused by the sun and moon's gravitational pull on Earth, making the ocean 'bulge' around its middle and pulling water away from the coasts. High and low tides therefore change over the course of a month. To avoid getting caught out by the tide and finding themselves high and dry, creatures must carefully time their activities to fit around the tides' schedule. Some have handy 'backup' plans, too. Limpets leave a trail of mucus, or slime, behind them when they search out food at high tide. They use the trail to return to the safety of the rocks where they clamp down ready for low tide, locking water inside their shell.

Key to plate

Rock pool at low tide, United Kingdom

1: **Montagu's blenny**
Length: Up to 8.5cm
Blennies can survive out of the water entirely. If they stay damp, they can breathe through their skin.

2: **Common limpet**
Diameter: 6cm
Limpets clamp on to rocks until the tide comes in. Their strong tongue then allows them to move around and eat algae off the rocks.

3: **Bladder wrack**
Length: Up to 100cm
This seaweed has air bladders which make it look a bit like bubble wrap and allows it to float.

4a: **Beadlet anemone (open)**
4b: **Beadlet anemone (closed)**
Diameter: Up to 5cm
These anemones will push others away that settle too close.

5: **Two-spotted goby**
Length: Up to 6cm
This fish swims above the seaweed rather than sheltering under rocks.

6: **Common starfish**
Diameter: Up to 30cm
These starfish are experts at opening shellfish using their tube feet.

7: **Lightbulb sea squirt**
Height: Up to 2cm
With a simple sac-like body and a covering called a tunic, these sea squirts look like a clump of lightbulbs growing on a rock. They are filter feeders so take in sea water and filter out the plankton.

8: **Common periwinkle**
Height: Up to 5cm
This sea snail can often be found in clusters around rock pools at low tide.

9: **Shore crab**
Carapace width: Up to 9cm
These crabs are usually green in colour but can also be orange or red. Their colour depends on age and whether it is breeding season.

OCEANARIUM

Gallery 5

Fish

Coral Reef Fish

Seahorses and Pipefish

Rays and Skates

Sharks

Habitat: Mangrove Forest

Coral Reef Fish

The coral reef is one of the most diverse and beautiful ecosystems in the ocean and the animals that live there all rely on it in some way for their survival.

Coral reef fish often have beautiful patterns and bright colours which means they can blend in, or camouflage, against the coral. The vibrant appearance of the fish might also be used to attract a mate and certain colours can also give a warning – reds and yellows often mean that an individual has venomous spines, poisonous skin or a sharp bite.

Many coral reef fish have clever ways to find food. With specially adapted mouths, surgeonfish and parrotfish graze on the algae that grows on the surface of coral. By removing the algae which would otherwise smother the coral, these herbivores help to keep the reef alive. Some fish, such as butterflyfish, consume the coral itself, clearing small patches so new coral can grow.

Predators, such as sharks, also roam the reef, hunting for food. Small coral reef fish, like damselfish and anthias, use the reef's many hiding places such as caves and tunnels.

Key to plate

1: **Longnose butterflyfish**
Length: Approx. 22cm
These fish use their long snouts to pick food such as small crustaceans from the coral crevices.

2: **Mandarinfish**
Length: Up to 6cm
Instead of scales, these fish have a mucus coating which protects them from bumps and bruises as well as parasites.

3: **Powder blue surgeonfish**
Length: Up to 23cm
This fish is named for the sharp scalpel-like spine it has either side of its tail.

4: **Coral hind**
Length: Up to 50cm
These fish draw food into their mouths using powerful suction and then swallow their prey whole.

5a: **Emperor angelfish (juvenile)**
5b: **Emperor angelfish (adult)**
Length: Up to 40cm
These fish love to feast on sponges, helping to keep sponge growth down in coral reefs.

6: **Clownfish**
(seen inside anemone)
Length: Up to 11cm
This brightly coloured fish lures other fish into the anemone. The fish are then poisoned and eaten by the anemone (see page 20).

7a: **Bicolour parrotfish (juvenile)**
7b: **Bicolour parrotfish (adult)**
Length: Up to 80cm
Parrotfish are all born female, with some transforming into males later in life.

8: **Bluestreak cleaner wrasse**
Length: Approx. 10cm
These helpful 'cleaner fish' set up stations in the reef and 'clean' any fish who visit by eating any parasites on their bodies.

Seahorses and Pipefish

Despite their unusual appearance and misleading name, seahorses are in fact fish. They breathe using gills but they also have necks and bony plates covering their bodies and eyes.

In shallow habitats such as seagrass beds or coral reefs, seahorses use their curled tails to hold on tightly to their surroundings. This is because they are poor swimmers and would otherwise drift away. Despite being slow swimmers, seahorses are remarkable hunters. The shape of their head means they barely disturb the water around them, so can sneak up on their prey unnoticed. The seahorse will use rapid suction to catch its prey and then disintegrate the food: seahorses have no teeth and so cannot chew their food.

Unlike most other animals, it is the male seahorse that gives birth. The female will make the eggs, then pass them to the male to hold in his brood pouch, a special soft area of skin beneath the tail. The male will then look after the eggs until they hatch, forcing them out in a cloud of tiny babies, known as fry, after 10 to 25 days. In the meantime, the female seahorse will have made more eggs, ready to repeat the process.

Key to plate

1: **Ornate ghost pipefish**
Length: Up to 12cm
Pipefish are related to seahorses and have a straightened body and tail. While for all other species of seahorses and pipefish it is the male that gives birth, for this species it is the female.

2: **Long-snouted seahorse**
Length: Approx. 15cm
As its name suggests, this seahorse has a long snout but also a distinctive spiky mane.

3: **Leafy seadragon**
Length: Up to 24cm
Seadragons are related to seahorses and mainly found in Australia. The amazing leaf-like structures on the body of this leafy seadragon are purely for camouflage, allowing it to blend in with the seaweed.

4: **Big-belly seahorse**
Length: Up to 35cm
One of the biggest seahorses in the world, this species gets its name from its bigger than usual 'belly'. The males have even larger bellies because of their brood pouch.

5: **Bargibant's pygmy seahorse**
Length: Less than 2cm
These tiny seahorses are so well camouflaged in their coral habitat that they were only found when a piece of sea fan – a type of soft coral – was examined in a lab by marine biologist Georges Bargibant in 1969.

Rays and Skates

Rays and their cousins, skates, have been around for over 250 million years. At some point in their history, they retreated to the depths of the ocean and remain there today, gracefully gliding through the water or resting undetected on the seafloor.

They have a skeleton made of a tough, flexible tissue called cartilage, and most adopt a bottom-dwelling lifestyle, feeding on shrimp and crabs. Others, like the giant manta ray, are filter feeders, scooping plankton into their mouths as they move through the water.

It's often hard to tell the difference between a ray and a skate. From spots to marbled tones, both have sophisticated markings and patterns on their skin. Rays, however, have stings on their tails, while skates have a thicker tail, often with small fins. Rays use their stings to defend themselves, while skates have thorny spines on their backs and will usually cover themselves in sand to evade detection.

There are several ways these fish breed. Skates use a tough case known as a 'mermaids' purse' to house their young. It's placed on the seabed, disguised by seaweed and eventually covered in a layer of algae. The foetus will develop inside the purse for up to a year, emerging when ready. Rays, however, give birth to their young fully formed.

Key to plate

1: **Bowmouth guitarfish**
Length: Up to 3m
Also known as a 'shark ray', this fish's body shape is a cross between a shark and a ray.

2: **Spotted eagle ray**
Width: Up to 3m
This ray uses its long, thin tail to sense any movement behind it.

3: **Giant oceanic manta ray**
Width: Up to 7m
These are the largest known rays in the world.

4: **Marbled electric ray**
Length: Up to 60cm
This ray uses its electrical charge defensively and can deliver up to 200 volts of electricity in one hit – the same voltage as an electric lawnmower.

5: **Knifetooth sawfish**
Length: Approx. 3.5m
Sawfish all have a long, tooth-edged nose, called a rostrum, which has pores for detecting electrical fields. The sawfish can use this to detect hidden prey who give off electrical impulses.

6: **Bluespotted ribbontail ray**
Width: Approx. 35cm
The bright blue spots on this beautiful ray warn of a dangerous sting.

7: **Undulate ray**
Length: Up to 1m
Despite its name, this is a species of skate. It gets its name from the rise-and-fall motion it creates with its wings while swimming.

Sharks

Sharks have roamed the ocean for around 450 million years. Today there are over 500 species, with a huge variety of size, shape and lifestyle. Often feared by humans, the truth is that only a handful of species are responsible for bites, and attacks are incredibly rare.

With an enormous habitat to hunt in, sharks must use their excellent senses to track down food. Along with their incredible sense of smell, sight, touch, taste and hearing, sharks have an extra sense that allows them to detect the electricity produced by the muscles of living things. They can sense this via tiny, jelly-filled pores that are dotted around their head. Known as *Ampullae of Lorenzini*, these pores are able to detect very low charges in water – great white sharks can detect one millionth of a volt.

To save energy while travelling long distances, sharks have special streamlining scales known as dermal denticles. Shaped more like teeth, the scales all point the same way – from nose to tail – and allow sharks to cut through the water easily. Sharks also have a super-light cartilage skeleton, which provides extra speed. The only bony part of a shark is their teeth, which are unique to each species and perfectly suited to their prey. They form in multiple rows in a shark's mouth and will constantly re-grow throughout their lives.

Key to plate

1: **Epaulette shark**
Length: Up to 90cm
These small sharks will often use their fins to walk on the seabed, rather than swim.

2: **Great white shark**
Length: Up to 5m
This fearsome predator can keep its blood temperature up to 8°C higher than the surrounding water.

3: **Common thresher shark**
Length: Up to 5m
This shark uses its extra large caudal fin, or tail fin, to stun fish.

4: **Cookiecutter shark**
Length: Up to 56cm
This small shark attaches itself to larger animals to bite off chunks of flesh. The perfectly rounded bitemarks give this shark its name.

5: **Basking shark**
Length: Approx. 8m
The basking shark is the second largest fish in the world (the whale shark is the largest).

6: **Tasselled wobbegong**
Length: Up to 2m
This incredible camouflaged shark looks like coral or algae to an unsuspecting fish.

7: **Oceanic whitetip shark**
Length: Approx. 3m
These sharks are named for the white markings at the top of their large, rounded fins.

Habitat: Mangrove Forest

Mangrove trees can survive conditions that would kill most other plants. Growing in tropical coastal areas, these tough plants can cope with salty water, intense sunshine, changing tides and crashing waves. Standing on stilts in the water, prop roots spread out from the trunk, strengthening the mangrove trees so they can withstand storms.

Where these roots enter the water, they create caves and tunnels – the perfect hiding places for fish and other small animals. This is especially useful for young animals, including lemon shark pups, which use the mangrove as a nursery before starting their adult lives and venturing out into the ocean.

Because mangrove trees grow along coastlines, they offer excellent natural protection from the force of the sea. Without mangroves, coastal communities would experience more frequent damage from storms that blow in from the ocean. Mangrove forests also play an important role in sheltering young fish. These fish will go on to support food chains across the ocean, providing food for thousands of different animals – including humans.

Key to plate

Mangrove forest, South East Asia

1: **Fiddler crab**
Carapace width: Up to 2cm
Males have one small claw and one large one, which they wave in the air to attract a female.

2: **Mangrove plant**
Height: Approx. 30m
Mangrove plant leaves filter out as much as 90 per cent of the salt from the water its roots absorb.

3: **Barred mudskipper**
Length: Up to 19cm
Also called the silverlined mudskipper.

4: **Hardyhead silverside**
Length: Up to 12cm
These little fish live in big shoals.

5: **Indo-Pacific tarpon**
Length: Up to 45.5cm
Adult tarpons tend to be found at sea, but young fish live in the shallows at river bays and mangrove forests.

6: **Sicklefin lemon shark**
Length: Up to 3.8m
When these sharks are pups, they shelter and hunt in the mangrove.

7: **Silver moony**
Length: Approx. 12cm
Stripes make it hard for other animals to tell which way the moony is facing.

8: ***Rhizophora racemosa* seed**
Length: Up to 30cm
Mangrove seeds drop into the water, then drift until they find a good spot to settle and grow.

OCEANARIUM

Gallery 6

Mammals

Cetaceans

Pinnipeds

Manatees and Dugongs

Habitat: Kelp Forest

Cetaceans

Whales, dolphins and porpoises are all members of a group of marine mammals called cetaceans. Found throughout the ocean from the tropics to the freezing poles, all cetaceans are able to swim enormous distances and stay warm.

Cetaceans, like land mammals, are warm-blooded, breathe air with their lungs and feed their young milk. Yet despite their similarities, cetaceans have very different ways of feeding to other mammals. Toothed whales have small, sharp teeth suited to hunting and killing large prey, while baleen whales use brush-like baleen, which is made from keratin just like human hair and nails, to filter tiny plankton from the water. As air-breathers, cetaceans also need to hold their breath to hunt for prey. Sperm whales can dive to depths of around 2,250 metres and can hold their breath for up to 90 minutes.

Cetaceans often feed and breed in different parts of the ocean, meaning they must travel huge distances every year. Incredibly, humpback whales are known to complete a 16,400 kilometre round trip, travelling between the Equator and the Antarctic. Good communication is essential during these long journeys. Dolphins use clicks and whistles, while whales use deep-sounding songs. As well as being the largest animal in the world, blue whales are also one of the loudest. A male's song can reach 188 decibels – louder than a jet engine! Their songs can be detected by other blue whales hundreds of kilometres away.

Key to plate

1: **Short-beaked common dolphin**
Length: Up to 2.4m
Found in groups of hundreds, if not thousands, of individuals, these animals are very social.

2: **Commerson's dolphin**
Length: Up to 1.5m
These small dolphins are playful, often swimming upside down or leaping into the air.

3: **Sperm whale**
Length: Up to 18m
This deep-sea diver is known to prey on giant squid.

4: **Harbour porpoise**
Length: Up to 2m
Porpoises look very similar to dolphins but have a shorter beak with flatter, spade-shaped teeth.

5: **Humpback whale**
Length: Up to 16m
Despite their name, these whales do not have a hump on their back, but they do make a curved shape when diving underwater.

6: **Common minke whale**
Length: Approx. 10.2m
One of the smallest baleen whales, this species is often preyed upon by orcas (see page 66).

7: **Beluga whale**
Length: Up to 5m
Like all polar whales, the beluga has no dorsal fin. This means it can swim beneath the ice without scraping itself.

Pinnipeds

The pinnipeds group consists of three types of marine mammals: seals, sea lions and walruses. These tough predators are fast and agile and are able to survive in the coldest water on Earth. Usually found swimming underwater, pinnipeds use land or ice floes to escape predators.

True seals have large eyes that work well in the dark, a thick coat of blubber and fur, and no visible ear flaps. They usually breed on solid ground or on ice floes around the Arctic or Antarctic, but don't live on land as they can't use their back flippers out of the water. Instead, they must use their strong stomach muscles and short front flippers to pull themselves forward.

Sea lions and the closely related fur seals are agile, graceful swimmers and can twist and turn in the water much more easily than seals. They often spend time out of the water and can rotate their flippers forward so that they can walk on land. Sea lions and fur seals have visible ear flaps, whereas true seals only have ear holes.

The walrus is a hefty creature who spends a lot of time in the water hunting for clams and other invertebrates. The walrus has enormous tusks, or teeth, which can measure close to a metre. They are used to keep ice holes open in the winter – essential for any air-breathing mammal living on the ice.

Key to plate

1: **Ribbon seal with pup**
Length: Up to 1.6m
The striking patterns of the ribbon seal develop as they grow. They are born white and later moult, looking like their parents at around four years old.

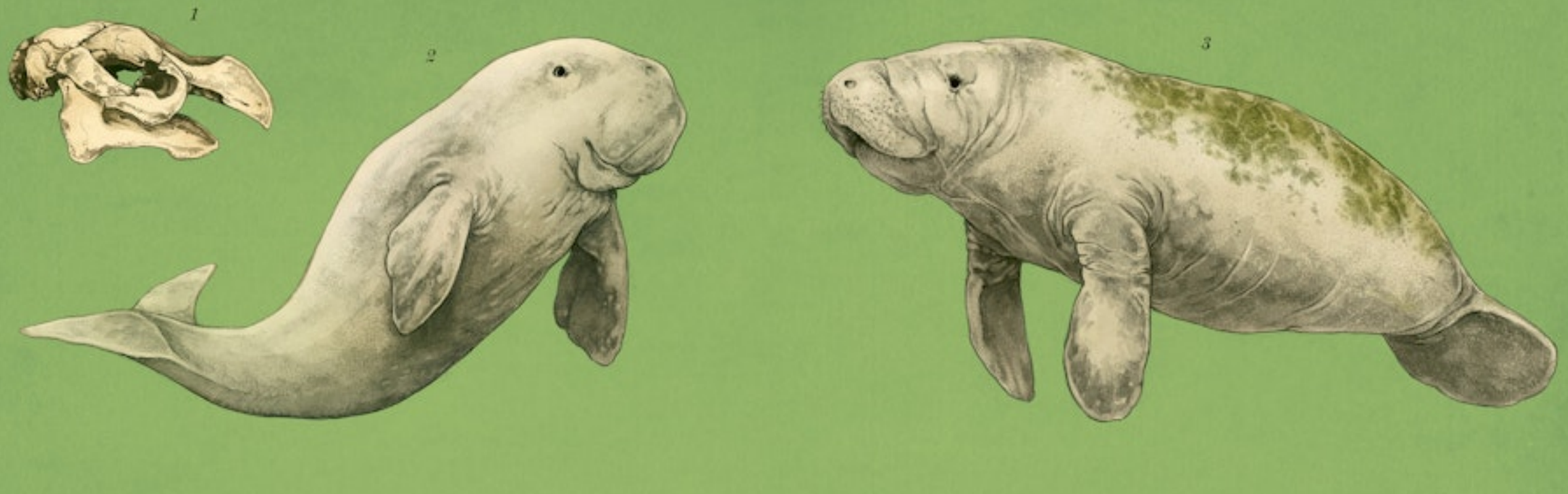
2: **Antarctic fur seal**
Length: Up to 1.8m
With fur popular as clothing in the eighteenth and nineteenth century, this seal was almost hunted to extinction.

3: **Californian sea lion**
Length: Up to 2.4m
Like all pinnipeds, sea lions have vibrissae, or whiskers, around their faces, which help them to pick up on movements in the water made by prey.

4: **Walrus**
Length: 2.2–3.6m
Weighing over 1,500kg, these adults may eat as many as 6,000 clams in one feeding season.

5: **Harbour seal**
Length: Up to 1.9m
Harbour seals live along the northern coasts of North America, Europe and Asia.

6: **Southern elephant seal**
Length: 2.6–5.8m
One of the deepest diving mammals, this species has been recorded at depths of 2,000m. The males have trunk-like noses which they use to attract females.



Manatees and Dugongs

Gracefully swimming in shallow waters, resurfacing every few minutes to take a breath, these marine mammals were once mistaken for mythical creatures by sailors. Today, manatees and dugongs are known as sea cows.

Dugongs live in tropical waters and use their strong, flexible upper lip to pull up seagrass. This often disturbs small invertebrates, making an easy meal for golden trevally fish that often trail alongside the dugongs, using them for protection.

There are three species of manatee, all named for their different locations: the West African manatee, Amazonian manatee and West Indian manatee. Unlike dugongs, manatees can travel into rivers from the sea, and the Amazonian manatee lives exclusively in freshwater. Manatees don't have insulating blubber so they must migrate in the colder months to guarantee water temperatures of at least 15°C.

Affected by toxic algae blooms (see page 12) and the loss of their warm water habitat and seagrass feeding beds, numbers of manatees and dugongs are in decline and many species are now on the endangered species list.

Key to plate

1: **Steller's sea cow skull**
Length of skull: Approx. 61cm
Hunted to extinction by 1768, all that remains today of the Steller's sea cow are fossils. They reached enormous sizes, growing up to 10m long.

2: **Dugong**
Length: Up to 3m
Dugongs are slightly smaller than manatees. They have fluked tails made up of two lobes joined together, similar to dolphins. There is only one species of dugong alive today.

3: **West Indian manatee**
Length: Up to 3.5m
Manatees are distinguishable from dugongs via their large, rounded paddle tail and nails on their flippers. The West Indian manatee is the largest member of the group.

Habitat: Kelp Forest

Kelp is a kind of seaweed that grows in cool coastal regions. Unlike plants on land, seaweeds have a holdfast instead of roots, which grips to the rocky seabed, ensuring the kelp is locked in place. Each holdfast has one or more stipes, or stalks, reaching up to the surface. Some types of kelp grow as tall as 45 metres, forming vast forests that tower above the seabed.

All ecosystems need a delicate balance between photosynthesising organisms (such as seaweed), herbivores and carnivores. In the kelp forest, this balance is best seen in the relationship between kelp, sea urchins and sea otters. Sea urchins graze on the kelp, making space for new plant growth. Sea otters then feed on the urchins, keeping their numbers down and ensuring they don't eat all the kelp.

Kelp forests are vulnerable to climate change as warming seas bring less of the nutrients needed for kelp growth and poor water quality reduces the light levels needed for photosynthesis. It is possible therefore that, as our ocean warms, kelp forests may move further north to cooler waters.

Key to plate

Kelp forest, Californian coast, United States of America

1: **Bull kelp**
Length: Approx. 36m
Bull kelp extract is used in food products, including ice cream.

2: **Southern sea otter**
Length: Up to 1.4m
Sea otters were hunted extensively for their fur in the 1700s and 1800s. Their numbers have slowly recovered, but they are still an endangered species.

3: **Garibaldi fish**
Length: Approx. 30cm
Male fish defend their nest year-round, and in the spring will clean the nest and entice females in with swimming performances.

4: **Giant kelp**
Length: Approx. 45m
Giant kelp can grow as much as 45cm a day, making it one of the fastest-growing organisms on Earth. When detached from the seabed, it floats in mats, giving shelter to many animals.

5: **Leopard shark**
Length: Approx. 1.6m
Young sharks are experts at finding snails and crabs under the sandy seabed and often visit kelp forests.

6: **California sheephead**
Length: Approx. 91cm
This species starts out as a female and turns into a male later in life.

7: **Purple sea urchin**
Length: Approx. 10cm
These sea urchins are a threat to kelp forests. Since 2014, 95 per cent of the bull kelp forests in Northern California, USA, have been devoured by them.

8: **Rockfish**
Length: 12–104cm, depending on species.
Some rockfish can live for around 100 years.

OCEANARIUM

Gallery 7

Birds

Seabirds

Habitat: The Poles

Seabirds

Seabirds make up around 3.5 per cent of all bird species. Whether they spend the majority of their lives gliding over the waves like the wandering albatross or visit the ocean only to collect food like the puffin, these birds all have a connection to the sea.

The hunting methods of seabirds vary: some, like the blue-footed booby, will plummet almost 30 metres from the air into the sea, diving underwater in pursuit of prey. Others surface feed, skimming the water while still in flight. Penguins have given up flight altogether and have strong, short wings that behave more like flippers, providing powerful swimming strokes underwater.

Many seabirds migrate to breed, with some travelling enormous distances. Wandering albatross have been known to fly around 16,100 kilometres in a single journey, barely flapping their wings. Instead, they use the wind, catching updrafts to keep themselves airborne.

The emperor penguin is the only animal that spends the winter in Antarctica. This amazing animal will walk 80 to 120 kilometres inland to breed in colonies. Once the egg is laid and hatched, the pair will take turns to guard their chick while the other returns to feed at sea. Only by working together can they raise the next generation of emperor penguins in such extreme conditions.

Key to plate

1: **Herring gull**
Wingspan: Up to 1.5m
Now more of a scavenger than a predator, gulls will take food from bins and directly from people!

2: **Wilson's storm petrel**
Wingspan: Up to 42cm
This bird hovers just above the water's surface so it can pick at the plankton just underneath.

3: **Red-billed tropicbird**
Wingspan: Up to 1.1m
A favourite food for this bird is flying fish, which they are known to catch in mid-air.

4: **Wandering albatross**
Wingspan: Up to 3.5m
Wandering albatrosses can spend years at sea without returning to land once.

5: **Blue-footed booby**
Wingspan: Up to 1.5m
The booby's bright blue feet are used by the males to attract a mate.

6: **Australian pelican**
Wingspan: Up to 2.6m
This species has the longest beak of any known bird, reaching up to half a metre.

7: **Atlantic puffin**
Wingspan: Up to 63cm
When the breeding season is finished, these birds shed their colourful beak plates and eye patches.

8: **Emperor penguin**
Height: Up to 1.2m
This is the largest penguin species.

9: **African penguin**
Height: Up to 70cm
The only penguin to be found on the continent of Africa, this penguin has to cope with hotter environments.

Habitat: The Poles

Some of the most extreme environments on Earth are found at the North and South poles. With temperatures as low as -80°C, winds that reach 161 kilometres an hour, and darkness for half the year, these ice-covered regions are home to only the toughest creatures.

Antarctica, known as the South Pole, is found at the southernmost tip of our planet and is a continent that is covered in and surrounded by ice. The Arctic, or North Pole, is the area of ocean at the most northern part of Earth. Despite its extreme conditions, it is home to a wide variety of wildlife. One of the reasons for this is the nutrient-rich cold waters which provide the perfect conditions for phytoplankton to bloom (see page 12). These important microscopic creatures are the very first link in the food chain, which includes top predators like polar bears and orcas.

The fluctuating levels of ice at the poles can affect the life cycles of the wildlife. Humpback whales, for example, swim from their breeding grounds to the Arctic or Antarctic during the summer to access water usually trapped under ice during the winter. But that sea ice is melting unnaturally fast due to climate change, damaging the habits of these creatures. It is therefore vital that we monitor and reduce our impact on these vulnerable parts of the world.

Key to plate

An Arctic ice shelf, Arctic Ocean

1: **Arctic tern**
Wingspan: Up to 75cm
These birds migrate between the Arctic and Antarctic each year, an amazing distance of 35,000km.

2: **Polar bear**
Length: Up to 3m
The biggest bear in the world, the polar bear spends most of its time on the Arctic sea ice but it is also a strong swimmer.

3: **Narwhal**
Length: Up to 5.5m
Male narwhals have spiral-shaped horns which can reach up to 3m.

4: **Arctic cod**
Length: Approx. 32.5cm
Amazingly, Arctic cod have a kind of antifreeze in their blood. This stops them from freezing in the icy waters around the poles.

5: **Orca**
Length: Up to 8m
These top predators are one of the most intelligent cetaceans (see page 54) and are able to communicate so they can hunt together.

OCEANARIUM

Gallery 8

Reptiles

Sea Turtles

Habitat: Galápagos Islands

Sea Turtles

Sea turtles have lived in the ocean for around 200 million years, making them one of the oldest reptiles alive today. With their thick protective shells, streamlined bodies and powerful webbed flippers, they are perfectly adapted for life at sea. Often completing journeys of thousands of kilometres across entire oceans, they are strong swimmers.

In a similar way to humans using satellite navigation, turtles use the planet's magnetic field to find the beach on which they were hatched, returning every season to lay their own eggs. This long journey is then followed by the enormous physical challenge of dragging their heavy bodies out of the water, digging a large hole and laying their eggs – sometimes up to 100 in a nest. When their job is done, the females return to the sea, leaving the eggs to incubate beneath the sand. Many predators lie in wait for the eggs to hatch, so the babies will all emerge at the same time, racing down the beach towards the sea. Once in the ocean, they will spend their whole lives in the water, with females only leaving to lay their own eggs, returning to the beach once more.

When not sleeping, eating or mating, turtles migrate between feeding and breeding areas. Leatherback turtles have been known to travel 16,000 kilometres in search of jellyfish to eat, while some loggerhead turtles swim nearly 13,000 kilometres from Japan to Mexico to feed, then return to Japan to breed.

Key to plate

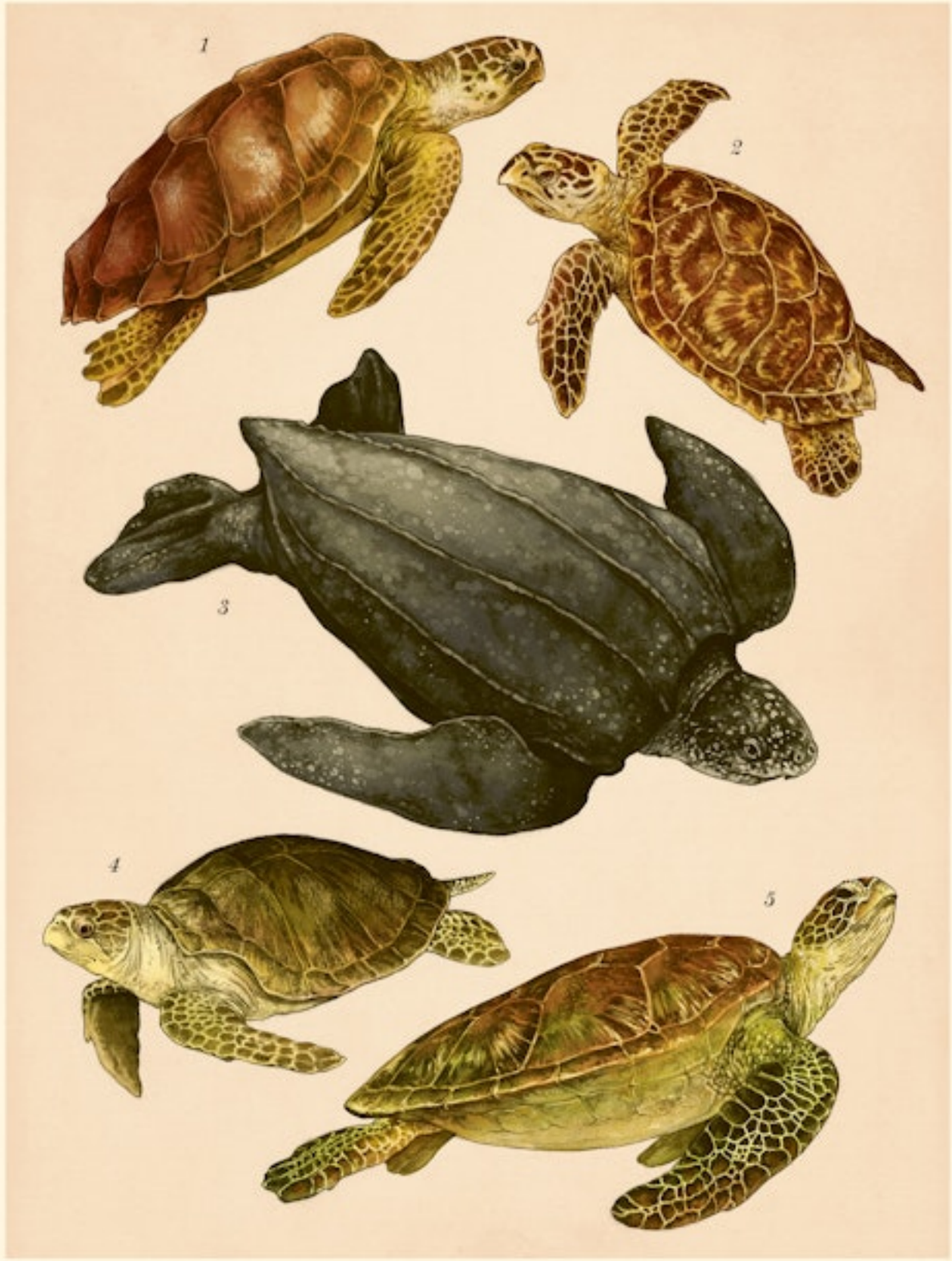
1: **Loggerhead turtle**
Shell length: Approx. 1.2m
Named for its large head and strong jaws, these turtles are able to crush clam shells and crunch sea urchins.

2: **Hawksbill turtle**
Shell length: Up to 90cm
This turtle has a unique shell. Its shell sections (called 'scutes') overlap, creating a beautiful pattern.

3: **Leatherback turtle**
Shell length: Up to 2.2m
Weighing around 500kg, leatherback turtles are the largest living sea turtles. Unlike other turtles, they can swim in colder waters.

4: **Olive ridley turtle**
Shell length: Up to 60cm
This small turtle nests in huge numbers in an event called an 'arribada'.

5: **Green turtle**
Shell length: Approx. 1.2m
The green turtle is one of the largest sea turtles. They change their diet as they grow and are the only sea turtle to do so. They start life as omnivores eating both meat and plants and become herbivores as adults, eating mainly algae and seagrass.



Habitat: Galápagos Islands

The Galápagos Islands are located on the Equator, 1,000 kilometres west of Ecuador. Although the climate is usually hot, the Galápagos generally experience cool, drizzly weather. This is because of the Humboldt Current – an 800-kilometre-wide strip of cold, nutrient-rich water that passes the Galápagos, not only cooling the air above it, but also providing the nutrients needed for phytoplankton to bloom, triggering hundreds of different food chains.

Both above and below the water, the islands are home to lots of unique species, many of which are found nowhere else on Earth. This includes the marine iguana. Observed by Charles Darwin during his travels on board the *HMS Beagle* in 1835, these were among the creatures that inspired his theory of evolution.

Around 3,000 marine species live and feed in the Galápagos region and the islands are now a marine protected area. By limiting fishing and protecting wildlife, we can hopefully protect the unique nature of this incredible corner of the world.

Key to plate

Galápagos coastline, Republic of Ecuador

1: **Magnificent frigatebird**
Wingspan: Up to 2.4m
Male birds have a large red throat pouch, called a gular, that inflates during the breeding season.

2: **Galápagos penguin**
Length: Approx. 49cm
This small penguin can live in this tropical location only because of the cool waters of the Humboldt Current.

3: **Marine iguana**
Length: Up to 1m
The only marine lizards in the world, these iguanas scrape algae off underwater rocks.

4: **Flightless cormorant**
Length: Up to 1m
This species of cormorant is only found on the Galápagos Islands. They have very few predators but fishing poses a threat as it reduces their food supply.

5: **Bullseye pufferfish**
Length: Approx. 18cm
The name 'bullseye' comes from the circular markings on this fish.

6: **Scalloped hammerhead**
Length: Up to 2.5m
The large head of this shark gives it a wider field of vision.

7: **King angelfish**
Length: Approx 15cm
Males and females will pair for a whole breeding season, meeting to spawn every day.

8: **Sally Lightfoot crab**
Carapace width: Up to 8cm
These beautiful crabs live on the rocks just above the water.

OCEANARIUM

Gallery 9

One Ocean

Habitat: Open Ocean

Humans and the Ocean

Habitat: Open Ocean

Move away from the coast and you will eventually reach the open ocean: a vast expanse of water where there is no land in sight. For animals living here, food is hard to find and the distances are enormous.

The open ocean extends from the sea's surface to just above the seabed. Most creatures gather in the upper waters, where sunlight enables phytoplankton to photosynthesise. Phytoplankton need nutrients and these are carried from the land to the sea by rivers and streams. These nutrients only reach some parts of the ocean's surface, but where they do, they feed enormous blooms of phytoplankton, which in turn provide food for ocean creatures.

Smaller creatures often make up for their size by forming shoals. Predators find it difficult to pick out just one fish from a shoal so when targeted, fish tend to form a bait ball and pack in closer together. Bait balls can attract larger predators and they all have different ways to catch a meal. Whales lunge through the middle of the shoal, consuming hundreds of fish in one go, while sharks use their speed and power to outswim the fish. Of course humans also visit these open waters to catch fish to feed people back on land, putting a strain on the sea's dwindling resources.

Key to plate

Open waters, Pacific Ocean

1: **Blue flying fish**
Length: Approx. 20cm
Flying fish use their wing-like fins to glide above the water's surface. They can usually 'fly' around 50m, but on an updraft can travel up to 400m!

2: **Mahi-mahi**
Length: Approx. 1m
Females lay between 100,000 and 1 million eggs in one go, two to three times a year.

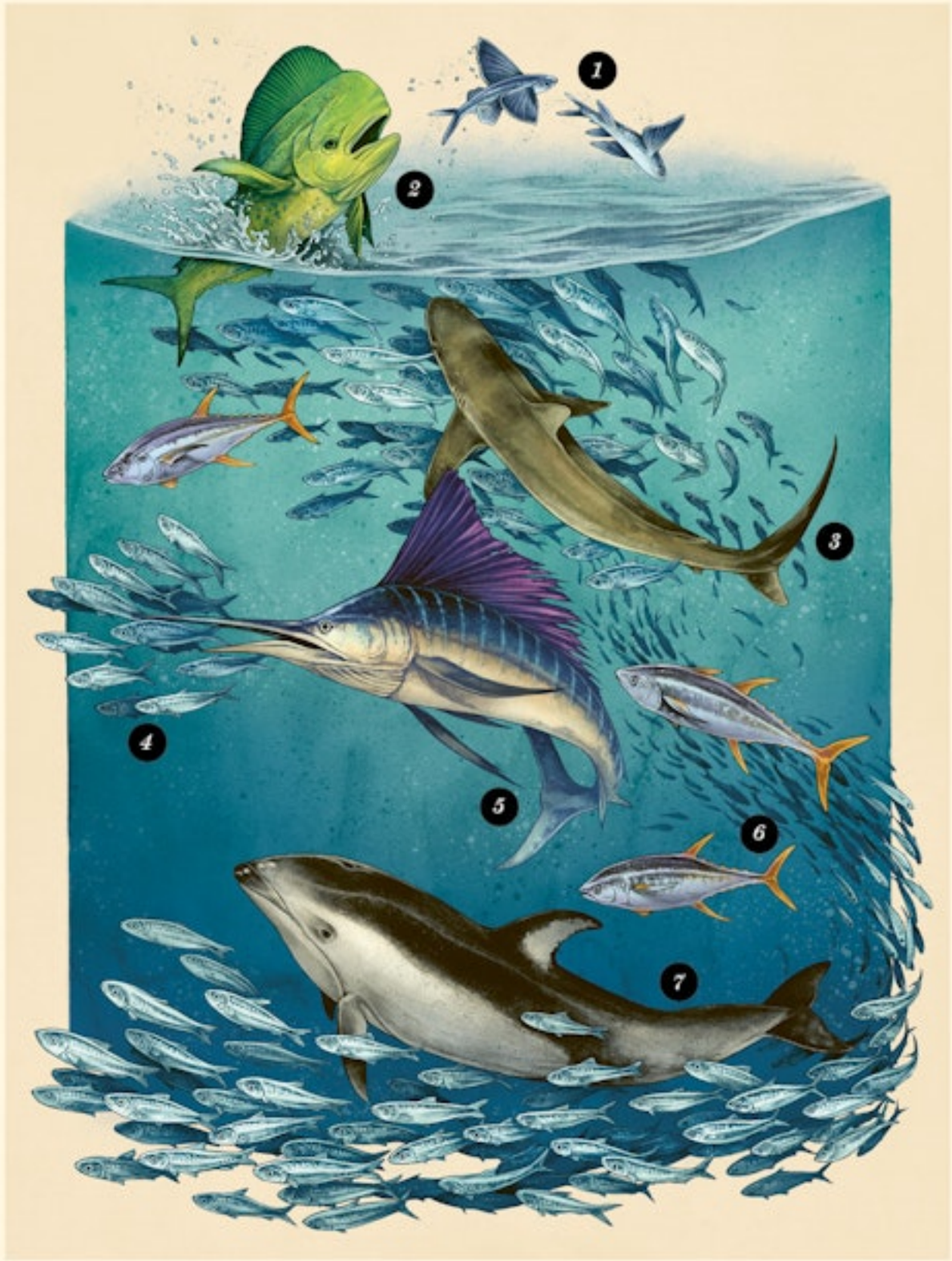
3: **Silky shark**
Length: Approx. 2.5m
These sleek open ocean sharks are found in warm waters.

4: **Pacific herring**
Length: Approx. 25cm
Herring fishing supports many communities along the Pacific coast of America.

5: **Indo-Pacific sailfish**
Length: Approx. 2.7m
the sailfish can reach speeds of up to 110km/h.

6: **Yellowfin tuna**
Length: Approx. 1.5m
Yellowfin tuna swim in large schools, often with other animals, such as dolphins.

7: **Pacific white-sided dolphin**
Length: Approx. 2m
White-sided dolphins often travel in 'super pods' of up to 100 individuals.



Humans and the Ocean

The ocean is one of humanity's greatest assets. Due to its immense size, it was once thought that the ocean was inexhaustible, but we now know this is not the case.

With a growing population, our dependence on the ocean has never been greater. An increased use of pollutants such as plastics, oil and greenhouse gases have led to parts of the ocean being unable to support the life they once did. But this can change.

The ocean is resilient and can recover if given time. Damage can be reversed if protective measures are put in place. Marine scientists and engineers have more knowledge and technology at their disposal than ever before, which have led to initiatives such as wind farms (providing sources of green energy); the rise of protected marine habitats (ensuring the survival of endangered species); more sustainable ways of fishing; and improved ways of living that can reduce our global carbon footprint. Whether it is by making small changes to our everyday lives or by campaigning and spreading the message – together, people can make a difference to the future of our oceans.

Key to plate

1: **Offshore wind farm**
Wind farms help to produce clean renewable energy. The UK currently has the world's largest offshore wind farm called Hornsea 2. In 2023, almost a third of the UK's electricity came from wind power.

2: **Agricultural runoff**
Pesticides used in crops can wash into rivers and flow into oceans, causing harm to many marine animals, also triggering harmful algae blooms (see page 12).

3: **Fish farms**
Sustainable fish farms take care not to damage the local environment or use harmful chemicals. They provide healthy food for people without taking animals from the wild.

4: **Large fishing boat**
Large ships can spend weeks at sea, catching thousands of tonnes of fish.

5: **Ecotourism**
Ecotourism encourages support for local communities and marine habitats.

6: **Marine Protected Area (MPA)**
Only around 8 per cent of the world's ocean is protected, but studies show that these areas allow fish populations to recover. The Global Ocean Alliance has therefore set a target to protect at least 30 per cent of the global ocean by 2030.

7: **Coral bleaching**
Coral reefs lose their colour when the ocean's temperature rises or its chemical composition is altered (see page 22).

Glossary

Adapted The process of change that means an animal is better suited to its environment.

Bioluminescence The production of light by living things through chemical reactions in their bodies.

Camouflage Colours or patterns that help an animal to blend in with its surroundings and hide from predators.

Carapace The protective shell on the back of some animals such as tortoises or crabs.

Carnivore An animal that eats meat.

Cartilage Tough but flexible tissue found in the body of an animal.

Cold-blooded Having a body temperature that changes according to the environment.

Currents The constant movement of seawater driven by forces such as gravity.

Ecosystem An area where living creatures such as plants and animals interact with non-living things such as soil, water, temperature and air.

Endangered A species at risk of becoming extinct.

Evolution The process by which living things change over time.

Extinct A species of animal or plant than no longer has living members.

Filter feeder An animal that feeds on particles or small organisms strained out of water.

Food chain A way to show how living things get their food. Some animals eat plants while some eat other animals. A food chain shows each link in the chain, for example, a giraffe eats leaves and a lion eats the giraffe.

Habitat The places where plants and animals live. A habitat provides the right type of food, water and shelter for the plants and animals that live there.

Herbivore An animal that eats plants.

Insulation A thick layer that stops heat escaping.

Marine Anything that relates to the seas and oceans.

Migration The movement of animals from one region to another at a particular time of year.

Nocturnal Awake and active at night, and asleep during the day.

Parasite An organism that lives on or in another plant or animal and gets its food from or at the expense of its host.

Photosynthesis The process plants use to take the energy from sunlight and use it to convert carbon dioxide and water into food.

Polyp Tiny animals that resemble sea anemones and live in huge groups called colonies.

Predator An animal that hunts other animals for food.

Prey An animal that is hunted or killed by another for food.

Spawn Animals that live in water such as fish and amphibians lay their eggs, or 'spawn', in water. This type of reproduction is called 'spawning'.

Species A particular type of plant, animal or other living thing.

Toxin A poison produced by a living thing.

Venomous Able to produce a fluid called venom, which is poisonous to animals and humans.

Warm-blooded Having a body temperature that usually remains the same. Warm-blooded animals can make their own heat, even when it is cold outside.