



Conservation Education

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Into the deep blue sea.....

Look at the earth from outer space and you will see a beautiful blue planet. It's blue, because an amazing 70% of the earth's surface is covered in water, and most of that water is in the world's oceans.



There are five oceans in the world which are all linked to each other. These are the Pacific (the largest), the Atlantic, Indian, Arctic (the shallowest) and the Southern Ocean which surrounds Antarctica. Linking these oceans are seas, which are often partly enclosed by land such as the Mediterranean, Caribbean and South China Sea.



Oceans and Weather

Oceans have a significant effect on weather patterns around the world. They form a major part of the water cycle, as water evaporates from the oceans' surface, cools and condenses to form clouds. Covering such a large surface area, oceans also absorb a lot of incoming solar radiation. Hot and cold currents (streams of moving water) transfer this energy around the world, heating land and air in the winter and having a cooling effect in the summer. The North Atlantic current, otherwise known as the Gulf Stream, is one of the strongest ocean currents in the world, pulling warm air over Britain. Without it Britain would be about five degrees centigrade cooler than it is now and could even enter another ice age.

Currents and Waves

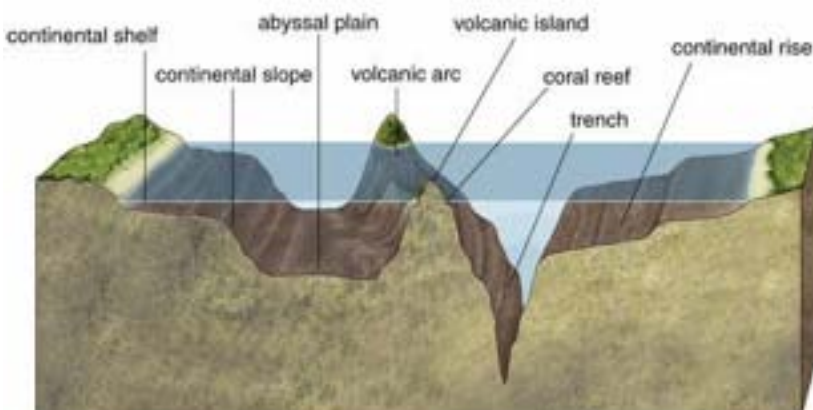
Currents are the movements of water. They are influenced by wind, temperature, the density of the sea water (dependent on salt levels), the shape of the ocean floor and the earth's rotation. Waves on the other hand only move up and down, not horizontally and are caused by wind blowing on the water's surface. **Tsunamis** are giant waves, wrongly called "tidal waves" because they are not caused by tides at all but usually by underwater landslides, earthquakes or volcanic eruptions which suddenly displace a huge volume of water. Between eighty and ninety percent of tsunamis occur along the rim of the **Pacific Ocean**, known as the "**Ring of Fire**". This is a horseshoe shape of tectonic activity where about eighty one percent of the world's largest earthquakes take place.



(c) Dorling Kindersley

Common hot water currents are marked in red and cold water currents are in blue.

As on land, the ocean floor is not always flat. It has mountains, hills, volcanoes and trenches too, formed when tectonic plates have collided and forced one below the other. In total twenty-two under sea trenches have been discovered, eighteen in the Pacific Ocean. The **Marianas Trench** near Japan is the deepest place on earth. At its deepest point it is 10,924 metres below sea level. It is so deep that you could fit Mount Everest inside it and it would still be covered with a mile of water. But even at these dark depths, there is an amazing array of life. For example, the Angler fish which has the special adaptation of a light on the end of a stem protruding from its head to attract its prey.



Why Is the Sea Salty?

Approximately 97% of the world's water is found in oceans and it's all salty! Fresh water travels from wherever the rain falls, down streams, sometimes underground, into rivers and finally out to sea, picking up lots of mineral salts from the rocks and soils of river beds along the way. When water evaporates from the sea as part of the water cycle, the salts are left behind, which is why the sea is so salty! However, this gets diluted by more fresh water entering.

Ocean Commotion.... The saltiest seas are the Red Sea and the Persian Gulf. This is because a lot of the water evaporates in the sun, but there is little fresh water flowing in.

The ice around the north and south poles, despite being frozen sea water, is not salty because the salt is excluded when the ice crystals form. Global warming is causing more ice to melt, which is adding fresh water to the sea and is making it less salty. This could affect wildlife. All water-dwelling species are specially adapted for certain levels of salinity. Those living in coastal areas and rock pools are specially designed to cope with varying levels, but many species are not so adaptable.

Less salty seas could further disrupt the earth's climate. Salinity (saltiness) makes sea water denser than freshwater. The density of the water influences the circulation of ocean currents from tropical waters to the poles. As we have seen, the ocean currents control how heat is distributed throughout the world and regulate the earth's climate.

Seamounts are mountains under the sea which are rich in biodiversity. The longest mountain range in the world is not on land but under the sea. It's the Mid-oceanic ridge system. Stretching from the Arctic Ocean to the Atlantic, it is four times longer than the length of the Himalayas, Andes and Rockies combined!

Creatures of the Deep - Ocean Species

The world's oceans are mysterious, containing millions of life forms, some yet to be discovered. It is thought that possibly 85% of all the plants and animals in the world live there, but we only say "possibly" because we know more about outer space than we do about what lurks in the depths of our oceans! There could be anything between 500,000 and 5,000,000 species waiting to be discovered.

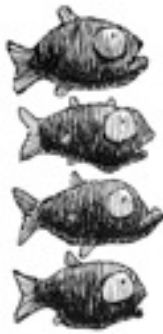
Teeming with life, oceans contain some of the strangest creatures in the world, which might as well come from outer space! There are tiny species like plankton and giants like the blue whale, the largest creature to have ever lived on earth, weighing up to 150 tonnes! Many tales existed amongst sailors of ocean creatures which sound completely made up. But if you take a closer look at them, you can see where they got their ideas from! Sadly many of these species and eco-systems are under threat.

Fish

Many creatures that live in the sea are commonly thought to be fish when really they are not. Fish are vertebrates which means they have a backbone. Invertebrates including shellfish, cuttlefish, jellyfish and starfish are not fish at all because they do not have a backbone. Other creatures such as dolphins and whales are warm blooded mammals.

Fishy Fact: the fastest fish in the ocean is called a sailfish. It can swim up to 70mph!

A fish's shape gives a big clue to where in the ocean it lives. Streamlined fish live in the open seas where they can swim quickly. Slower fish often live on the ocean floor, sometimes in shallower waters and have features to protect themselves, since they have less chance of escaping from predators.



Mackerel

There are a number of species of fish known as mackerel, but they all resemble what you would imagine a "typical" fish shape to be – streamlined, with a dorsal fin along its back and pectoral fins at the sides. Like all fish they breathe through their gills which extract oxygen from the water.



Mackerel have plenty of predators such as marlin, sharks, dolphins, whales and sea birds such as the shearwater. Perhaps its for this reason that a female can lay up to one million eggs at a time.

Stingray

The flat stingray dwells in tropical waters on the ocean floor, where it blends in with the sand. They tend to stay in one place, so they defend themselves using a stinger at the end of their tails, in some species up to 15cm long. Their sting is usually venomous and can kill a human, but they only attack in self defense. Their greatest enemy, the shark is also a species they are closely related to. Like sharks stingrays have electrical sensors around their mouths which help them to detect natural charges coming from potential prey such as clams, oysters and mussels.



George Chang – CC BY-NC-ND 2.0

Sharks and stingray are both cartilaginous fish which means that they don't have skeletons made from bones but cartilage. This causes some debate and confusion as to whether they are true fish, which are vertebrates with backbones or not.

Food chain:

plankton → crustaceans → molluscs → stingray → shark

Fishy Fact: One species of stingray that does like to move about is the Golden Cow-nose ray of the Gulf of Mexico. Twice a year they move to fresh feeding grounds in "fevers" – groups of as many as 10,000.

There are around seventy species of stingray but because they are a popular food in certain parts of the world, their future is at risk. However, where waters have warmed due to climate change, some species are thriving.

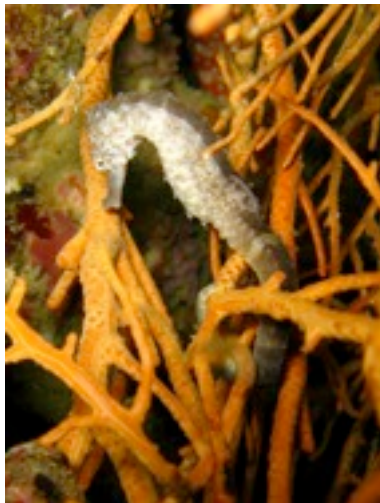
Sea Horses

These upright swimming fish are found in shallow waters. A small fin runs down their backs which flutters up to 35 times a second, but their shape means they are not strong swimmers and can die of exhaustion if they are caught in rough seas. They use their prehensile curly tails to hold on to seagrass in the underwater meadows where they shelter.

Related to the pipe fish, their jaws don't move. Instead a pipe leads into their body through which they suck up any plankton or tiny crustaceans drifting by. They have to eat continuously to survive since they have no stomach to hold the food.

Fishy Fact:

a group of seahorses is known as a herd.



Seahorses mate for life but uniquely they are the only species in the world whose males bear the young. Eggs are deposited in his pouch by the female which the male then fertilizes. There are 35 species in the world, ranging in size from 1.5 – 35cm long. Two species can be found in UK waters – the short-snouted and the spiny seahorse. Sadly seahorses are vulnerable to collection for Asian medicine, all kinds of pollution and habitat loss, caused for example, when boats raise their anchors and rip up the sea grass where they live.

Marine Conservation Areas.

In light of the way our oceans have been plundered, there are calls for 40% of the world's oceans to become marine reserves and the other 60% to be controlled by sustainable fishing methods, in the hope that species have a chance to recover. The fishing industry could benefit from this in the long term, if healthy stocks overflow from the protected zones into areas where they could be harvested.

Currently only 0.7% of the world's oceans are under legal protection. The 2002 Convention on Biological Diversity and the World Summit on Sustainable Development committed to protect 10% of the world's oceans by 2012, but this date has been postponed until 2020.

Over Fishing

Fish is both tasty and nutritious, but therein lies the problem. A rising number of people are eating increasing amounts of fish. Despite their vast nature the oceans are being depleted of resources to the point where some



fish stocks have been completely wiped out. Species in most demand are bluefin tuna, cod, marlin and swordfish. Sometimes these are caught illegally to the value of somewhere between \$4.9 – 9.5 billion. In the mid to late 1960s twenty million tonnes of wild fish was caught annually. Since then this number has soared to eighty-four million tonnes.

Discards

In UK waters the amount of cod trawlers are allowed to catch is restricted by quotas set by the European Union. These were set with the intention that cod numbers would be allowed to recover. However, once their quota has been met, the trawlers will continue to fish for other species. As the North Sea is a mixed fishery, it is inevitable that cod will still be caught among other fish, but they cannot be landed and sold. Instead they are thrown back dead. Haddock and plaice are two other species which get thrown back if they reach their quota. Others species are thrown back because they are not popular fish with consumers and won't sell.

Fishy Fact: The EU estimates that between 40-60% of the total catch in the North Sea are discards.



Derek Keats – CC BY-SA 2.0

Fishy Fact: Half of all the fish caught in the North Sea are thrown back overboard - dead!

In July 2011 the European parliament reviewed their Common Fisheries Policy and published a new one, which included proposals for a discard ban. This came about thanks to huge public pressure as a direct result of a televised campaign called "**Hugh's Fish Fight**". We must wait to see if these proposals become law. You can join the campaign on www.fishfight.net

Fishy Fact: In the UK cod, salmon and tuna account for more than 50% of the fish we eat!

Fishing Methods

There are an estimated 3.5 million fishing boats across the world, mostly small boats belonging to local fishermen. **Large industrial vessels** which are responsible for 60% of the catch make up just 1% of the total number of vessels. These often employ methods which not only are damaging to fish stocks but also harm other wildlife. Such methods include **long line fishing**. Although illegal in many cases, this is a very effective way of catching fish. A line which can be up to 80 miles long has thousands of hooks attached along its length, baited with pieces of squid and fish. Unfortunately this is very tempting to sea birds such as albatrosses, the biggest of the sea birds, which dominate any feeding frenzy. Once hooked by their beaks they are dragged underwater where they drown in a painful manner. This is the fate for many albatrosses across the world's oceans, including the critically endangered short-tailed albatross.



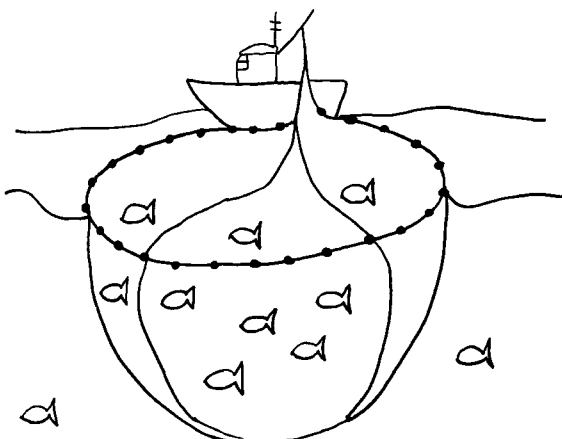
Fishing trawlers



Chris Pearson - CC BY 2.0

21 out of 24 species of albatross are in danger of extinction. Around 400,000 albatrosses and giant petrels die each year due to long line fishing.

Purse Seine nets are nets which make a wall around a shoal of fish and then the bottom is pulled together scooping up the shoal. This is an effective fishing method but is not suitable for those species of fish which shoal with other species such as skip-jack tuna, as it increases the chance of by-catch, especially when **Fish Aggregation Devices** (FADs) are used. FADs attract not only the target species but also endangered sharks, turtles and other fish species such as big eye and yellow fin tuna.



Anything caught on lines or in nets which is not the intended catch and is of no commercial value is known as **by-catch**. By-catch forms about a quarter of the overall catch. This not only means fish, but also species such as dolphins and turtles. An estimated 60,000 whales and dolphins are killed each year when they are caught on hooks or tangled in lines and nets. In the case of **tuna fishing**, after a high profile televised campaign called "**Hugh's Fish Fight**", (after the chef/journalist Hugh Fearnley-Whittingstall) many brands selling tuna have agreed to change their fishing methods from **long line fishing** to the more traditional **pole and line** method.



(c) Paul Hilton/Greenpeace

Purse seine fishing

Deep sea dwelling species, once safe from the exploits of man are now under threat from **bottom trawling**, whereby huge nets (some as wide as a rugby pitch) are dragged along the sea bed, weighed down with large metal plates rollers which crush everything that stands in their way. It is highly destructive, destroying corals, sponges and other creatures as well as rock formations. These sensitive eco-systems take hundreds of years to recover from such damage. The target species such as hake, plaice or sole make up only a small proportion of what is caught. In some areas such as part of the Mid-Atlantic ridge, this practice has been banned.

Sharks

What is a shark? Many people in Western cultures have the image of Jaws in their minds, since childhood, but it is said that more people are killed each year by dogs, falling coconuts and lightning strikes than are killed by shark attacks! There are in fact at least 355 confirmed species of shark and only 20 of these are considered dangerous to humans. Not all sharks are restricted to tropical waters. Some can be found in British waters, such as the dogfish.



Fishy Fact: Great White Sharks can travel 12,000 miles in nine months. They are listed as a vulnerable species.

Fishy Fact:

There are three species of plankton eating shark. One is the basking shark, the biggest fish to be found in British waters at 12 metres in length! Another is the whale shark - the biggest fish in the world! And finally, there is the megamouth shark!



Whale shark

Sharks have excellent senses of sight, hearing and smell and can also detect electro-magnetic fields surrounding other creatures. They have a large oily liver which helps them to float but have keep moving all the time, because their bodies are so dense that they would sink to the bottom. As apex (top) predators, they are vital for the healthy balance of the oceans' eco-systems.

According to "The International Action Plan for Sharks" one hundred shark species are being commercially exploited and many shark species are in decline. They are highly prized for their fins to eat, liver oil for

cosmetic purposes, their teeth as jewellery, jaws for souvenirs and skin for leather products. But the main cause of their decline is overfishing, according to a 2009 report by the International Union for Conservation of Nature. Of the sixty four species of open ocean (pelagic) sharks and rays studied, they found that 32% were threatened with extinction.



Shark fins

(c) Hofford/Greenpeace

Shark Finning

Hunting sharks is nothing new, but shark meat is almost worthless. However a kilogram of shark fins can fetch US\$700. So rather than waste space in their boats with whole sharks, fishermen cut off their fins while they are still alive and the rest of the shark is dropped back into the water.

Without its fins, a shark cannot swim and if it can't move then its gills won't work effectively either so the shark either drowns or is eaten alive by other fish. Campaigners are fighting for this cruel practice to be banned internationally, as it currently can only be banned in the waters of countries which choose to do so.



Jay Tong - CC BY-ND 2.0

Shark fin soup is a popular delicacy in oriental restaurants costing over US\$100.

Every year somewhere between 20 and 100 million sharks are killed by people. The number is difficult to discern since the practice is unregulated where it is not illegal. But we do know that demand for shark fins is increasing whilst shark populations are decreasing.

Apart from banning shark finning, another measure to control the practice is only to allow sharks to be brought in to shore with the fins still attached, ensuring that less individuals are caught. Sharks are slow to mature and reproduce so this harvesting of them is unsustainable and will ultimately result in species becoming extinct. Sharks have been around for about 400 million years, even before dinosaurs, so their disappearance due to the actions of people would be a great shame.

Invertebrates Creatures without a back bone.

Cephalopods

Found in oceans all over the world, cephalopods are “head footed” creatures with “arms” surrounding their heads, such as **octopuses, squid, cuttlefish and nautilus**. Squid range in size from the smaller coastal squid to the giant squid of the deep oceans which grows up to 10 metres long and has giant suckers the size of tea cups! Falling under the category of “molluscs”, by definition you might expect these soft bodied creatures to have a shell, but not all cephalopods do. All that remains of a shell in the squid is what’s known as a “pen”, an internal feather-like structure inside the squid which supports its body.



Cuttlefish

Jet powered! Squid are sometimes called sea arrows due to their ability to dart around in the water in any direction, including backwards, as well as being able to hover in one spot. Squid and cuttlefish manoeuvre using their fins but also have a special funnel tube inside them for propulsion, which they squirt water through in one direction to send them off the opposite way! This capability to move swiftly in any direction helps them to be effective hunters, grabbing their prey, with their two longer arms and holding it still with the other eight. For defense they can change colour from red, yellow, brown, greenish to white and striped! They can also mask themselves in a cloud of brownish ink which they squirt from their bodies before making a quick escape.



Giant squid

Ocean Commotion: Cephalopods have three hearts which pump blue blood!

The Giant Squid is the biggest invertebrate in the world! They are 10m long and weigh around 200kg. Along with the colossal squid, they also have the largest eyes of any creature in the world, 25cm in diameter! This helps them to see in the pitch black depths of the ocean where most creatures would not see anything at all. They mainly eat fish, shrimps and other squid.

Octopuses: Eight Legged Love

We don't normally associate creatures such as the eight legged octopus with having human emotions. Yet observing the female's behaviour, we can become quite sentimental about these strange creatures. Take the giant Pacific octopus. The female makes a den perhaps under a large rock and closes off the den with more rocks before she starts laying eggs. Over a three week period she lays around 57,000 eggs which she weaves together in groups of around two hundred and hangs from the roof of the den.

For six and a half months, the female constantly grooms the eggs to ensure that no algae, bacteria or colonial animals grow on them and kill them. She also blows water over the eggs to provide a continual oxygen supply. Then one night the mother helps the babies to hatch by blowing on them and shaking them about. As soon as the tiny 6mm long babies have hatched, they swim towards the surface of the ocean



Ocean Commotion: Octopuses can lose one of their arms to a predator and regrow it later!

as far as thirty metres away. Her task complete, the exhausted mother removes some of the rocks from the entrance to the den and dies soon afterwards. Her body quickly becomes food for marine scavengers like crabs and sea stars.

Sea Cucumbers

Lying on the ocean floor, sea cucumbers are not something you would eat in your salad, although they are farmed and eaten as a delicacy in Asian countries. They are classed as echinoderms, feeding on algae, tiny animals and detritus (waste from plants and animals) by the tube feet which surround their mouths. They act a bit like terrestrial earthworms, breaking down larger particles into smaller ones, which bacteria can more easily break down and return to the eco-system.



Ocean Commotion: As means of defense sea cucumbers can use sticky threads to trap their predators or even expel some of their internal organs through their anus!



Sea Urchins

Another brain-less echinoderm, sea urchins are the hedgehogs of the sea! They come in many colours including black, purple, green and white. Their hard exterior is made up of bony plates covered in spikes, some venomous, for protection. Additionally they can use their five tiny tube feet for shifting seaweeds, pieces of shell and rocks to hide away from predators such as crabs and sea otters. Their underside has five teeth for eating seaweed and other organic matter, including dead fish!



Sea Stars

Also known as star fish, these 2000 species of echinoderms can be found in many parts of the seas. Most have 5 arms, but some have 12, 20 or even more! A starfish has legs so strong that it can pull apart the shell of a clam or oyster. Then it turns its own stomach to the outside of its body to suck up the juicy shellfish.



Starfish have no brains as such, but instead their nervous systems are spread throughout their arms. In fact the most vital organs are in its limbs. Amazingly, if a leg is severed they are able to grow a new one and even the severed limb may develop into a whole new star fish! In common with other echinoderms they also have no blood but use filtered sea water instead.

Jelly Fish

Jelly fish float along in the ocean currents and can squeeze their bodies to push themselves in the direction they want to go. They use their tentacles to sting and paralyze their prey before eating them. This could be fish, shrimp, crabs and plankton and even other jelly fish. More humans are killed by jelly fish than by sharks, but they don't attack on purpose. The most deadly is the Australian box jelly fish which carries enough poison to kill 60 people.

Their bodies are very simple and are 98 percent water but they never stop growing during their lives. A hole in the body of a jelly fish is both its mouth and bottom! Along with squid, jellyfish are the favourite food of marine turtles.



Sea anemones

These flowers of the sea are not as harmless as they may seem and are able to paralyse passing fish with their venom-filled tentacles. There are over 1000 in the world ranging in size from 1.25 cm to 1.8 metres wide. One fish which is safe from its snare is the clown fish. It is protected from being stung by a layer of mucus, so it can live within the anemone's tentacles as a safe haven from predators whilst at the same time the anemone benefits from the clown fish's left overs as a tasty snack! This is known as a symbiotic relationship.

Mammals

Many aquatic species such as whales and dolphins are mistaken for fish, sharing some of their features such as a tail and fins. However these are warm blooded mammals, which do not have gills and must come up to the surface for air. They don't lay eggs but always give birth to live young who suckle their mother's milk. Other sea mammals include seals, sea lions and walruses.



Sperm whale blowing

Aquatic mammals breathe through a blow hole – a nostril on the side or back of the head. In whales the direction of the “blow” (the fountain of water which sprays out from the nostril) helps scientists to determine which species they are looking at and indeed which individual, helping them to track the animals' movements. They can also identify whales from the shape of their tails. Other sea dwelling mammals are Sirenia or dugong “sea cows” in the Indian Ocean and manatees which are found in shallower waters off the east coast of North America. Both are herbivores.

Ocean Commotion: How can you tell the difference between a whale and a fish? Simply by looking at its tail – a whale's is horizontal and moves up and down, whereas a fish's tail is vertical and moves from side to side.

Whales

Whales are grouped as “cetaceans” along with dolphins and porpoises. There are 78 species of whale which can be divided into two sub-groups, those with teeth (67 species) and those without (11 species), known as baleen whales.

Baleen whales

Baleen whales, such as humpback whales are filter feeders, using the “baleen” in their mouths like a giant sieve to filter out plankton and krill. Baleens are plates of whale bone with long bristles to strain out the krill. Blue whales are the largest creatures ever to have existed. Their tongues alone weigh as much as an elephant! Yet they energise their huge bodies by filtering and eating tiny krill. They tend to eat more when they are in the colder Arctic and Antarctic waters where there is a plentiful supply of food. They migrate to breed and give birth in warmer waters.



Baleen plate

Toothed species

Whales with teeth include the sperm, pilot and killer whale or “orca”. The sperm whale is the largest toothed whale, growing up to 20 metres long and weighing 50 tonnes. They are the deepest diving mammals in the world, with the ability to reach depths of 3,000 metres – nearly two miles, although most dives are somewhere between 300 and 600 metres. They can hold their breath for up to two hours! They hunt for squid and octopus using “echolocation”.

Ocean Commotion.... The sperm whale has the largest brain of any living creature in the world, weighing 8kg! Its heart weighs 126kg, about the weight of two people! Its teeth are 20 cm long!



Sperm whale teeth

Echolocation

Whales and dolphins rely on their sonar to navigate communicate with one another and for hunting. When a sound wave bounces off a shoal of fish and returns to them, they are able to locate their prey. Sperm whales make a clicking noise for echolocation, which is so loud that it can even stun its prey.



Beached fin whale

Ocean Commotion: The speed of sound is nearly five times faster through water than it is through air!

Strandings

Every year hundreds of whales, dolphins and porpoises are stranded off UK shores. No-one knows for sure why they do this but it is thought that a sick whale may head to shallower waters to avoid drowning, but get stranded when the tide goes out. Some whales are more likely to beach than others. Pilot whales are renowned for this, possibly because the “pod” (group) faithfully follows a beached whale rather than abandon it.

The noise from shipping, seismic surveys looking for oil and sonar from military ships/submarines is extremely loud! The sudden deafening sounds can shock a whale into surfacing too quickly, having the same effect as the bends in divers and can lead to mass strandings.

Whales may also become stranded because of bad weather out at sea or due to seismic activity. Two days before the 2011 earthquake in Christchurch, New Zealand one hundred pilot whales were stranded off the South Island. Also in 2011 fifty melon-headed whales were beached on the Eastern-Kashima shore in Japan before the earthquake there.

Commercial Hunting, Past and Present.

For hundreds of years whales have been hunted and traded for their meat, blubber, oil and bone. Whales still provide a vital source of food for communities in the Arctic circle where they have little else available to them. These people are still legally allowed to kill a small number of whales each year.

Despite attempts to regulate whaling in the 1930s and '40s, it still continued to the point where many were on the brink of extinction. When hunting blue whales was finally banned in 1966, their population had already declined by ninety nine percent.

In 1986 an international moratorium on commercial whaling was agreed by the International Whaling Commission. However, despite this, Japan, Iceland and Norway continue to whale on a commercial scale even though some species are still endangered. Since then Japan has killed 8,201 minke whales for “scientific purposes”, and now hunts humpback and endangered fin whales too.

Countries which would like the ban lifted argue that numbers have recovered sufficiently in some species to allow hunting to resume, for example humpback whales, which are no longer listed as endangered. Despite this some studies indicate that they number only a fraction of what they were previously. Dutch scientists took DNA samples to estimate what humpback whale numbers may have been before commercial whaling began in the 1800s and concluded that there could have been around 1.5 million, far exceeding previous estimates! In 1994 the Southern Ocean Whale Sanctuary was created but more recent attempts to form a South Atlantic Whale Sanctuary were thwarted when some countries' representatives walked out of the meeting.



(c) Greenpeace

Tourism & Whales

Shooting with cameras, not harpoons has become more popular in recent decades and the whale watching industry generates \$1.25 billion a year worldwide. The connection people feel when they see these gentle giants provides hope for the conservation of these incredible creatures. Care has to be taken to ensure that the whales are able to behave naturally and not feel like they are being chased or disturbed by boats. People must wait for the whales to approach them. Meanwhile, traditional lookouts once employed in the whaling industry now use their whale spotting skills for tourism instead.

Other Threats To Wildlife

Much of the wildlife in the oceans exists along continental shelves. The relatively shallower waters there makes wildlife more vulnerable to the effects of human behaviour. We have already seen how hunting and unsustainable fishing have affected life in the oceans, but these are not the only threats it faces.

Litter

Litter is a threat to wildlife, whether on land, or in water. The sea is so large that it has become a dumping ground for all sorts of waste, which often goes unnoticed. An estimated 50% of marine litter is plastic. Every year about 100 million tonnes of plastic are produced globally, of which about 10% ends up in the sea. Marine turtles can choke on plastic bags, mistaking them for their favourite food, squid. One turtle found dead in Hawaii had over 1000 pieces of plastic in its stomach and intestines.

Some rubbish floats, but about 70% of it sinks to the ocean floor where it

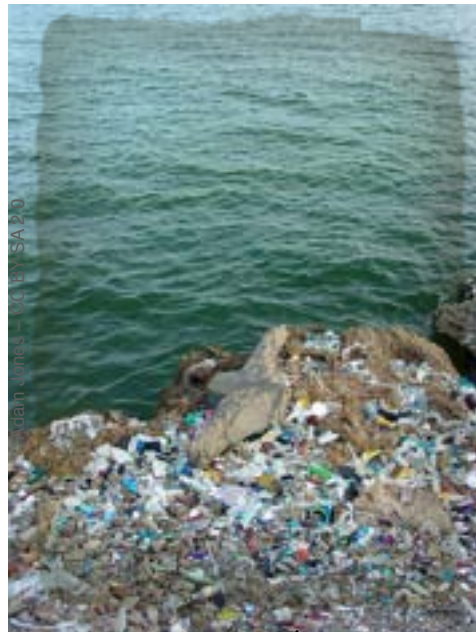
can smother the life down there. In the North Sea there are 110 pieces of rubbish for each square kilometre of seabed. This adds up to 600,000 tonnes of rubbish at the bottom of the North Sea alone! Much of the rubbish which ends up in the sea does not originate from sea vessels and platforms – this only accounts for about 20% of it. The other 80% is suspected to have originated inland from litter, dumping in rivers and from unfiltered sewage.



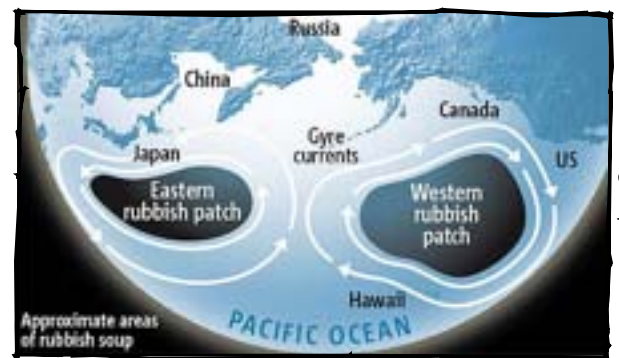
(C) John Moncrieff

Every year an estimated one million sea birds and 100,000 marine mammals and sea turtles are killed by eating or getting trapped in plastic rubbish.

UN Environment Programme.



Santo Domingo



(c) www.bagtheplanet.com

The Great Pacific Garbage Patch - one of 5 known major "gyres" in the world, where the currents swirl litter into patches. The Great Pacific Garbage Patch is twice the size of France - there are 6 kilos of plastic to every one kilo of plankton.

Sewage

Most sewage in developed countries is filtered and treated before it is disposed of. The sludge from solid waste can then be used as a fertilizer or be released into the sea. However, occasionally, after stormy weather, the drains and sewage pipes fill up to their limit and any excess has to be released directly into the sea, without treatment, through an overflow discharge pipe.



Nonsequitiass - CC BY-SA 2.0

Warning of sewage overflows during and following heavy rain

Bacteria present in untreated waste can make recreational users such as swimmers and surfers very ill unless they avoid those areas for a day or two until the problem has dissipated. Untreated waste is also unfiltered waste so items which people throw down their toilets, such as sanitary items and cotton buds, end up in the sea where they can harm wildlife. Cruise ships are also guilty of releasing human waste and detergents into the sea.



Keoni Cabral - CC BY 2.0

Combined sewage overflow pipe, San Diego

Toxins in the Food Chain

The strength, flexibility and enduring properties of plastic make it an extremely useful material. Yet it is these very qualities which make it a hazard to wildlife once it has fulfilled its intended purpose, since it doesn't break down easily, like biodegradable materials do, particularly in oceans where lower temperatures and lower UV light levels slow this process down. Instead, plastic breaks down into smaller and smaller particles, which can end up mixed in with grains of sand or resembling plankton which fish may eat. In addition to broken down plastic particles, sometimes drum loads or even ship loads of plastic pellets (used in the manufacture plastic products) are lost at sea.

Once plastic enters the food chain, the chemicals accumulate, so even top predators like polar bears have been found to have high levels in their bodies. Plastics also act as a kind of chemical sponge concentrating POP's (persistent organic pollutants) in areas of the sea where plastic has gathered. We mustn't forget that humans are not immune to pollutants, which can end up in the fish we eat. These are highly toxic and can damage children's development and affect human reproduction!

Nuclear Waste

Nuclear power stations, reprocessing plants and the military all produce nuclear waste. Since 1952 low levels of radioactive waste has been discharged into the Irish Sea, the English Channel and the Arctic Ocean.

Radioactive material needs to be isolated and encased (in glass and concrete) to prevent leakage and is costly to dispose of. Although radioactivity levels reduce over time, this can take weeks to thousands of years before it reaches safe levels. It also needs to be safe from terrorism and natural disasters. Lack of available space and proximity to people means that storing it at sea has been seen as a safer and more straightforward option. Any leakages are much more easily dispersed over a greater area in the sea, than in the air, although they can travel further.

So what long term effects might this have? Certainly radiation can enter the food chain though plankton and kelp and then go on to contaminate fish. What if these are then eaten by seals or humans? Radioactive caesium and plutonium has already been found in seals and porpoises in the Irish Sea.

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Nuclear submarine HMS Vanguard

Michael Spiller – CC BY-SA 2.0



Grey seals



Zooplankton - crustaceans

NOAA Photo Library – CC BY 2.0

Ocean Commotion: The blubber of dead whales in some places are so highly contaminated with organochlorines, PCBs and pesticides it would be classified as toxic waste!

Nuclear Disasters

When a nuclear disaster occurs, it is difficult to contain and control due to the radioactive material involved. The devastating earthquake in Japan on 11th March 2011 rocked the Fukushima Daiichi nuclear power plant and the tsunami which followed knocked out the plant's emergency generators. Huge volumes of water were poured onto the nuclear reactors to cool them and stop them from exploding, but cracks in the reactor then allowed the water to flow into the sea. The long term consequences of this catastrophe are yet to be seen, but many scientists think that levels outside of the danger zone are too small to pose any serious threat.

Nuclear energy is considered to be a solution to our excessive use of fossil fuels but will leave future generations to deal with the problem of what to do with the radioactive waste. Alternative, renewable energies may

be a better long-term solution such as off-shore wind turbines, tidal barriers and wave power which harness the energy of the sea. However, these have not, so far, been substantially developed and there are issues with them too such as the detrimental effect they could have on wildlife, such as wading coastal birds and migratory whales.

Oil Spills

Oil spills can happen when an oil tanker runs aground, perhaps in stormy weather or as a result of mechanical failure. The hull of the ship can rupture on impact or when it starts to move again. Major oil spills include the Exxon Valdez spill in Alaska in 1989 when 10.8 million (US) gallons/38,800 metric tonnes of crude oil was spilled into the oceans. It was sailing outside shipping lanes in order to avoid ice when it ran aground on Bligh Reef. In this case the ship did not have a double hull – a base with two layers, whereby even if the outer layer did get damaged, the oil would still have been contained in the inner hull. By law, every tanker must have a double hull by the year 2015, but this came too late to prevent the Exxon Valdez disaster.

The spill spread for approximately 1,300 miles. Many of the creatures which died would have sunk but based on the carcasses found, an estimated 250,000 sea birds, between 1,000 – 2,800 sea otters, 300 harbour seals, 250 bald eagles and up to 22 killer whales were killed, not to mention billions of salmon and herring eggs.



Controlled burning of oil from the Deep Water Horizon oil spill 2010

The Exxon Valdez oil spill released 257,000 barrels of oil into the sea, but this is merely a drop in the ocean in comparison to the Deepwater Horizon Oil Spill in 2010, which released 4.9 million barrels of oil after an oil rig exploded in the Gulf of Mexico. The extent of that disaster and its environmental consequences are still being discovered and debated.

The effects of an oil spill on wildlife are devastating. Thick with oil, fur and feathers clog up and are no longer effective at insulating a creature such as a sea otter and can cause hyperthermia. Sea birds need their feathers for buoyancy and if they can't fly it becomes harder



Marine Photobank – CC BY 2.0

*Oiled bird - Black Sea oil spill
11th December 2007*

for them to look for food and escape from predators so easily. When creatures try to clean themselves they can ingest the oil and be poisoned. Eating a fish which is coated in oil can also poison them. If they don't die, the oil can still damage their health and affects the rate of reproduction.

The full recovery of an area can take decades, as the delicate balance of the eco-system will have been upset. Prey may be less plentiful. At the bottom of the food chain, phytoplankton and other marine plants are less likely to survive as a coating of oil on the water's surface blocks out the sunlight needed for photosynthesis. Oiled spawning and rearing grounds have a detrimental effect on the fish population and this has a knock on effect up the food chain. Sub surface oil can come back to the surface to do more damage. Species already endangered are pushed that much closer towards extinction.

Detergents, used to remove the oil can also be damaging. These help to break up the spill and disperse the oil more easily but can also carry it to deeper waters where it can harm corals. Oil booms can prevent spills from spreading to wider areas and some of the oil can be burnt off. Many of the toxins are broken down by micro-organisms, but before this can happen fish, crabs and shellfish can take the toxins on board and they enter the food chain. Oil spills do not only affect the wildlife but the tourism the wildlife attracts, as well as the fishing industry and those restaurants and shops which rely on selling their catch.

Minor oil leaks occur all the time through human activities such as the routine maintenance of ships, drains (through the improper disposal of engine oil) and street runoff, air pollution and natural seepage. Combined, these release more oil than large accidental oil spills, but it is dispersed over a much greater area.

Ecocide! *The idea that a corporation can be held responsible for its actions in a court of law for environmental damage caused on purpose or through negligence has recently gained momentum. This may mean that corporations will in future do more to prevent disasters like oil spills occurring in the first place and take responsibility for the ongoing environmental damage they may be causing.*

Climate Change

As the earth's temperature rises, so does the temperature of the world's oceans. This is already causing more extreme weather events such as hurricanes to develop over the warm oceans along the equator. Warming temperatures in the Arctic and Antarctic are causing the ice to melt there too. Less white ice means less UV light can be reflected back into the atmosphere (the albedo effect) and more will be absorbed by the sea water which is now exposed.

As water heats up, it expands, causing sea levels to rise. In the future sea levels may also rise because of melting glaciers and ice sheets. These currently cover 10% of the world's land area and hold 75% of the world's freshwater. Additional freshwater in the oceans will change their salinity and affect marine species which are used to surviving in different salinity levels. It can also affect ocean currents – “see why is the sea salty?” on page 2.



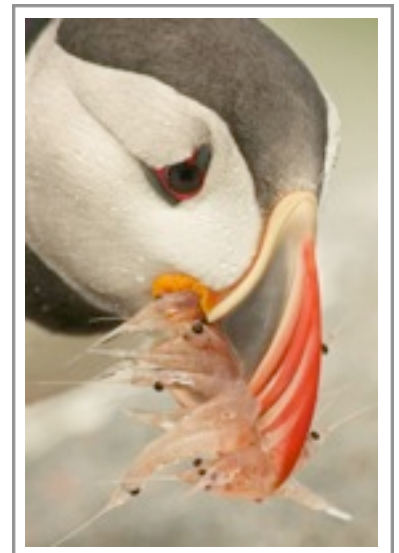
In the Arctic, lack of ice is reducing the times when polar bears are able to hunt, which sometimes leads to starvation. In the Antarctic the ice is needed for krill to complete their life cycles. These tiny shrimp like creatures are nearly at the bottom of the food chain, feeding on plankton. They are the food source for most of Antarctica's wildlife from penguins and seals to albatrosses and whales.

Food chain: *phytoplankton* → *zoo-plankton* → *krill* → *penguin* → *killer whale*



Emperor penguins

In the past 200 years, since industrialisation began, the world's oceans have been absorbing about half of all the extra man-made carbon dioxide emissions in the atmosphere. Some of the carbon dioxide is used for photosynthesis by phyto-plankton (tiny plants) and by sea creatures to form their shells. The sea is naturally slightly alkaline, providing conditions in which creatures with shells thrive. Millions of years ago, when these creatures died and sank to the bottom of the ocean they took the carbon with them and locked it away. Over time their compressed bodies fossilized and formed oil and gas which are now found under the sea or in deserts which used to be covered by sea. When we burn fossil fuels such as oil and gas, we release that carbon dioxide back into the atmosphere.



Atlantic puffin with krill

Due to increasing levels of carbon dioxide in the atmosphere, more of it is dissolving in sea water and is forming carbonic acid. This makes the water more acidic and hampers the sea creatures' ability to grow shells. Therefore, the more acidic an ocean becomes, the less able the creatures are to absorb more carbon dioxide – their loss will result in less carbon dioxide being locked away and more ocean acidification which also damages coral reefs. These creatures may be tiny, but with tens of billions of them all performing this function they are vitally important. Less of these tiny creatures will also have a knock on effect on the entire whole food chain.



Killer whale

Coral Reefs

Due to higher levels of carbon dioxide, the sea has become 30% more acidic in places. **Ocean acidification** alongside **rising water temperatures** cause coral reefs to become fragile and break or die. Coral reefs occur in shallow waters near the coast and require very specific temperatures between 21 – 30 degrees centigrade. Variations out of this range for any sustained period of time will cause the reefs to die. Unfortunately temperature records since 1961 show an increase in average sea water temperatures to a depth of 3,000 metres.



USFWS Pacific – CC BY 2.0

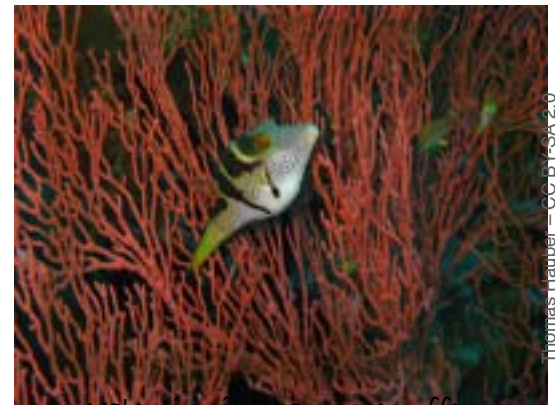
Thomas Hauber – CC BY-SA 2.0



Coral reefs are sometimes referred to as the “rainforests of the sea” since they are home to about a quarter of marine species that shelter among them, including clown fish, parrot fish, star fish, and turtles. As with a rainforest, new species are being discovered all the time. The reefs are made up of animal “**polyps**” which live in colonies and form limestone skeletons and tiny colourful algal plants which grow on them. They have a **symbiotic relationship**, meaning that they both rely on each other for survival. Both need clean water at the correct temperatures to survive and the algae needs light for photosynthesis. When the **algae**, which give corals their brilliant colours die, they turn white – this is known as “**coral bleaching**”.

Did you know....

The Great Barrier Reef is the largest coral reef in the world. Located off the north-east coast of Australia, it is 2000km long!



Thomas Hauber – CC BY-SA 2.0

Valentin's sharpnose puffer

Coral reefs are very important economically, supporting thousands of people employed in localised fishing and tourism industries. They also act as a barrier protecting the coast line from storm damage. Apart from climate change, coral reefs can be damaged by industrial fishing methods that use explosives or dredging and water pollution.

Case Study - Marine Turtles

Six out of seven species of marine turtle are endangered. There are many reasons for this. Turtles are often the victims of fishing methods when they are caught up in nets as by-catch. Litter, especially plastic, is a choking hazard for them, turtle shells are sometimes sold as souvenirs and turtle eggs are sometimes dug up from sandy beaches and eaten. Now climate change is putting them under even more pressure.



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Climate change is affecting turtles in several different ways:

1. Rising sea levels and more stormy weather means the beaches where they normally nest could get eroded or disappear underwater.
2. Coral Reefs, one of their habitats could die off, along with much of the life that inhabits them.
3. Sea grass beds where turtles graze are declining.
4. If temperatures in the sand on breeding beaches rise too much, there will be a bias towards females being born, since the temperature of an egg directly effects whether it turns out to be male or female.

What's Your Response?

- * We all have a choice of how much and which fish we buy. We can choose those with the sustainable fishing logo which shows the fish comes from healthy stocks.
- * We can buy the less commonly caught fish and look for tuna which has been caught using the pole and line method.



- * Try and eat a greater variety of fish, so that the pressure on the few popular species is eased. Try mackerel, flounder, dab, coley or pouting!

- * Join the "Fish Fight" campaign - for large industries to take notice, public pressure and publicity is what is needed. You can take part in these campaigns from your own home simply by looking at what various organisations are doing, signing their petitions, writing letters, for example to your MP or local supermarket and by donating money towards their causes.



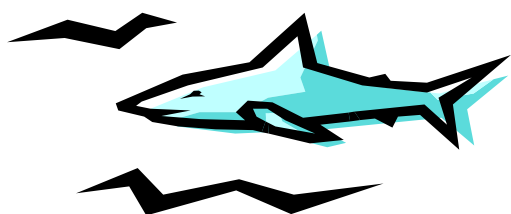
- * Never drop litter - use a bin - it may just save an animal's life. Try to avoid plastic in your lifestyle as much as possible and try and recycle what you use. You could even go on a litter pick!



- * Don't use your toilet as a bin! World Toilet Day is on **19th November** each year, to raise awareness of those 2.6 billion people without access to adequate sanitation facilities.

- * Reduce your carbon footprint to help fight climate change.
Energy - save it!
Transport - think walk, bike, public transport
Food - grow your own, local, organic
Waste - Reduce, reuse, recycle.

- * You could "adopt" a turtle or dolphin, whale or shark to help protect them in their habitat!



- * **June 8th is World Oceans Day** every year - why not use it as a day to promote our oceans! See www.worldoceansday.org



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Websites

Campaigns

Ecocide	www.thisisecocide.com
Fish Fight	www.fishfight.net
Greenpeace	www.greenpeace.org.uk/oceans
Sea Shepherd	www.seashepherd.org
Surfers Against Sewage	www.sas.org.uk

Conservation

Marine Conservation Society	www.mcsuk.org
Marine Stewardship Council	www.msc.org
Shark Trust	www.sharktrust.org

Information

Shark Information	www.sharkinformation.org
Transition Town	www.transitionnetwork.org
Whale and Dolphin Conservation Society	www.wdcs.org.uk

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