



SSC DIVE IN!

FISH, SHELLFISH AND FISHERIES MANAGEMENT





WELCOME!

Hello, and welcome to “SSC Dive In!”. Packs of resources providing some seaside fun directly into family homes and classrooms.

This pack’s theme: **Fish, shellfish and fisheries management**

The seas around Scotland support a large variety of fish and shellfish species. Many of those are caught for consumption as food and it is important that the way fishing is carried out is managed sustainably. ‘Sustainably’ means that stock is taken at levels which are compatible with the population replenishing each year.

Dive into this pack to discover more about this important part of our marine environment.

Inside this pack:

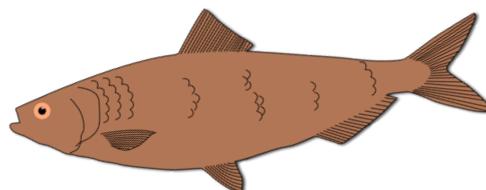
- **Fact file: Fish and Shellfish**
- **Discovery sheets: Species information**
- **Overview: Fisheries management**
- **Blog: Awesome oysters**
- **Quiz: Check your knowledge**
- **Experiment: Fish examination**
- **Guide to eating fish sustainably**
- **Glossary**

We’d love to hear from you! If you’ve had fun having a go at activities, experiments and crafts, let us know. Any comments or pictures can be sent to marineengagement@seabird.org. More resources are available on our [website](#).

Enjoy using our packs and want to see more? The Scottish Seabird Centre is an environmental conservation and education charity. Every penny we raise helps us deliver our important education and conservation work. If you enjoy using our resources and would like to support our work, please consider making a donation to our [JustGiving page](#). Thank you.

We hope you enjoy diving in to the pack!

Scottish Seabird Centre Learning Team





FACTFILE

FISH

WHAT IS A FISH?

Fish are animals that live in water and breathe by absorbing dissolved oxygen through their gills when water passes into their mouths and over these gills. Coming in many shapes and sizes, fish belong to a class of creatures called **aquatic vertebrates**. Their combination of gills, fins, and the fact that they live only in the water, make fish different from all other animals. Most fish have a skeleton made of bone but some, like sharks, have a skeleton made of **cartilage**. There are over 30,000 fish species in the world!

FISH GROUPS

Fish are grouped into three types: bony, jawless and cartilaginous (cart-ee-la-jee-nous). **Bony** fish form by far the largest and most varied group of fish (making up more than 9 out of 10 fish species). From herring to flatfish, and salmon to sticklebacks, fish with internal skeletons of bone have evolved into many forms and have adapted to many habitats.

Jawless fish form an ancient group of **vertebrates**, most of which are **extinct** today. The lampreys and the hagfish are the two small remaining groups. These primitive species look like eels and have no scales. There are three species of lamprey found in Scotland—the sea, river and brook lampreys.



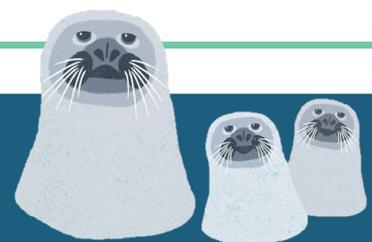
Sea Lamprey © Naturescot



© Frogfish Photography

Blue shark

Cartilaginous fish instead of having bones, have cartilage—this is what you have in your ears and nose. There are three main cartilaginous fish—the sharks, rays and skates. You can learn more about them in our [elasmobranchs Dive In pack](#).



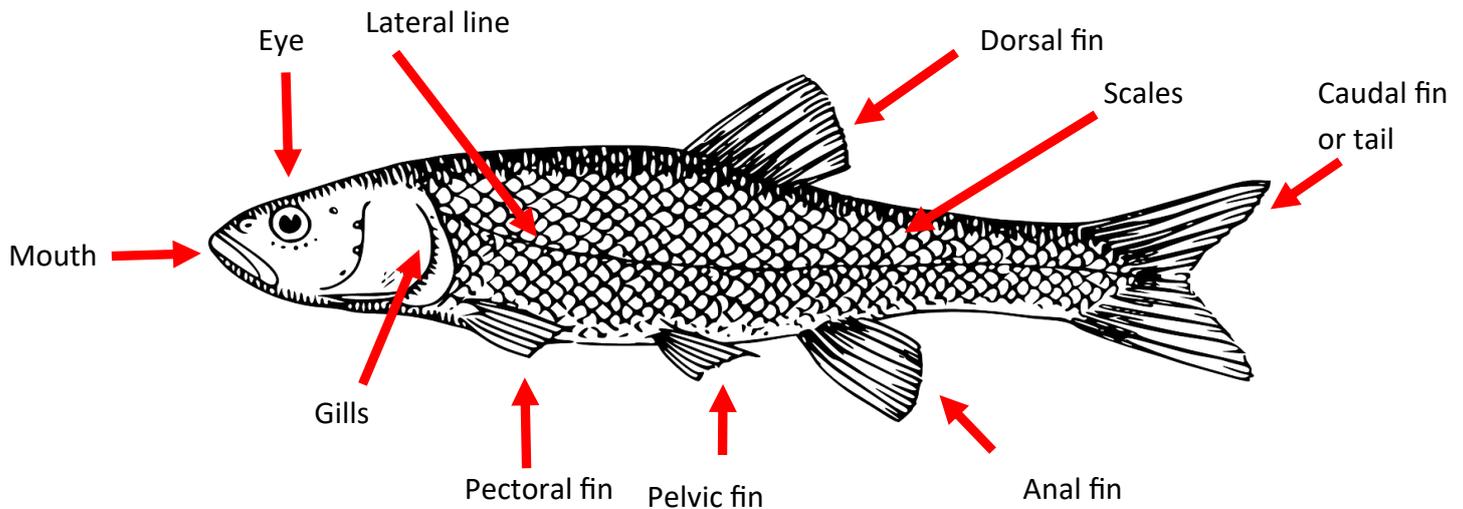
Hint: The meaning of words in **purple** can be found in the Glossary at the end of the pack. Words in **blue** contain links to websites.

FACTFILE

BONY FISH

WHAT ARE THE CHARACTERISTICS OF BONY FISH?

Bony fish have several characteristics which have been **adapted** to help their hunting, **locomotion** and avoid predation. They make up the biggest animal group within the **vertebrates**. The diagram below shows the special adaptations which have allowed them to be so successful.



- Eyes** If a fish is **pelagic**, its eyes are usually positioned on the sides of its head. This allows it to see predators and prey which are swimming nearby. However, if a fish is **demersal**, its eyes are normally on top of the body. This is because most other sea creatures will be moving above it.
- Fins** The tail (caudal fin) of a fish will either be forked or squared shaped. A forked shaped tail allows a fish to swim fast, whereas a squared tail allows a fish to move around obstacles such as rocks. The dorsal fins prevent fish from rolling over in the water. The pectoral and pelvic fins also help with balance, as well as stopping and changing direction.
- Gills** Fish have gills for breathing rather than lungs. As water passes over the gills, dissolved oxygen from the water is absorbed into the fish's blood stream.
- Scales** Fine scales cause less friction (the force created by two surfaces moving across one another) and are found on fast swimming fish. Fish that move more slowly or less often have larger scales.
- Mouth** Fish that feed on the seabed floor have their mouth below their body. The mouth of surface feeders is upturned and slanted upwards. Fish with large mouths 'gulp' their food.
- Lateral line** Fish have special cells on the sides of their bodies used to detect objects around themselves, including other fish and their location within the water. This helps fish which swim in groups to stay close together.



FACTFILE

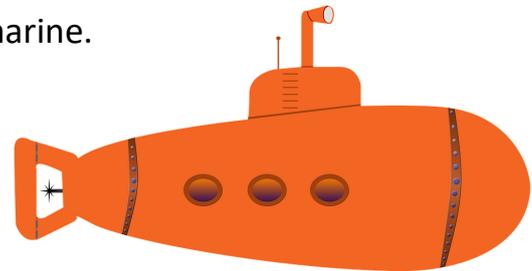
FISH

HOW DO FISH BREATHE?

Oxygen is as important to fish as it is to humans. Water holds low concentrations of oxygen. Fish use gills to take dissolved oxygen out of the water. Water comes in through the mouth of the fish, flows over the gills and leaves the fish through a bony flap called the operculum. Water passing through the gills flows past lots of tiny blood vessels. Oxygen seeps through the walls of those vessels into the blood, and carbon dioxide seeps out.

HOW DO FISH FLOAT?

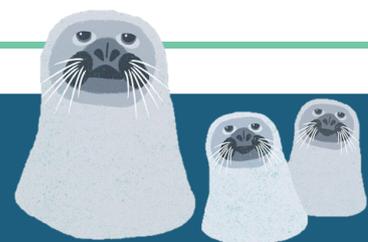
Most bony fish have a gas-filled organ inside their body called a **swim bladder**, which can expand and contract. By regulating the volume and pressure of the gas in the bladder, a fish can adjust their **buoyancy**—moving up, down or ‘hovering’ in the water. Buoyancy acts against gravity, which pulls the fish down. The upward force of buoyancy is also used in the movement of a submarine.



FISH LIFECYCLE



Most bony fish release their eggs and sperm into the water, where fertilisation then takes place. In marine species, the fertilised eggs tend to float as part of the **plankton** (usually in very large numbers as only a few will actually hatch). Once the hatched larvae become juvenile fish they often congregate in sheltered ‘nursery grounds’. Of course fish must expose themselves in order to feed and many bony fish use **camouflage** as a way of avoiding **predation**.

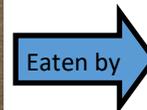
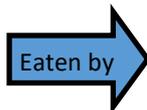




FACTFILE

SHELLFISH

Shellfish as the name suggests are aquatic animals which have a shell BUT they are not fish! Instead shellfish are **invertebrates** and are either molluscs, crustaceans (kru-stay-shuns) or echinoderms (eh-ky-no-derms). Most shellfish are low down on the food chain. They tend to eat plankton and in turn are a food source for many other marine creatures as well as humans.



MOLLUSCS

Molluscs are a diverse group of marine animals, found everywhere from the deep ocean to the intertidal (the part of the shoreline which receives splashes from waves but is never fully covered by tides). The group includes gastropods, bivalves and cephalopods (learn more about the latter in our [cephalopod Dive In pack](#)). We often eat **bivalve** molluscs, these are the shellfish which have two shells. Examples include oysters, mussels, scallops and cockles. When buying shellfish, it is important to check that these have come from local and sustainably managed shellfisheries.



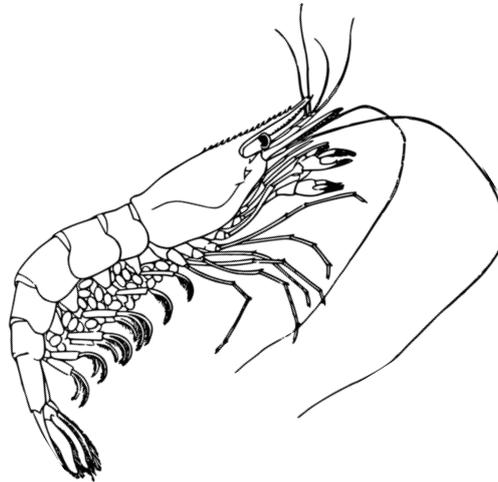


FACTFILE

SHELLFISH

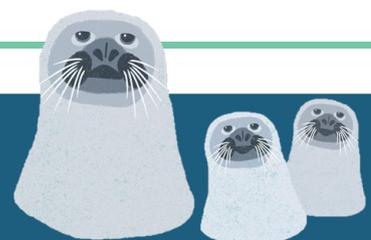
CRUSTACEANS

Crustaceans include crabs, lobsters, shrimps and barnacles. Some of these shellfish have less obvious shells. Many have exoskeletons (hard exteriors) and others, such as the hermit crab, even live in shells 'stolen' from other species. They also feature two compound eyes, two pairs of antennae, three pairs of mouth parts and many legs.



ECHINODERMS

The name of this group of **invertebrates** is derived from the Greek for 'hedgehog skin'. The group includes sea urchins, brittlestars, starfish and sea cucumbers. Echinoderms have radiating body parts, so most appear star-shaped, spherical or disc-shaped. They all have a skeleton of calcium-carbonate plates under the skin. Like many shellfish, echinoderms are filter feeders, sucking in seawater through their bodies and collecting food floating within.



EXPERIMENT

FISH INVESTIGATION

Why not try examining a fish at home, looking at what features it has and considering what these might mean about its lifestyle. Use our guide below to help you!



WHAT DO I NEED?

A fish

Tweezers

Gloves

Pencil

Hand lens/magnifying glass
(if you have one)

Tray or board

Ruler

Paper

Knife

1

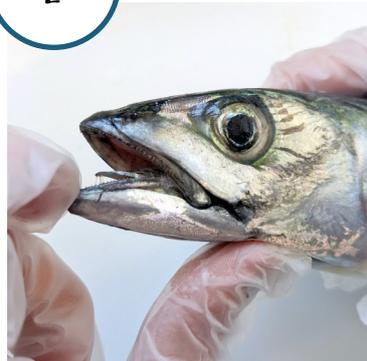
Have a general look at the fish. How many fins does your fish have and where? What shape is the tail? How are the mouth and eyes positioned? Can you see the lateral line?



2

Put your gloves on and gently examine your fish.

You can take a look inside its mouth, Can you see teeth and a tongue? The teeth may be very small.



3

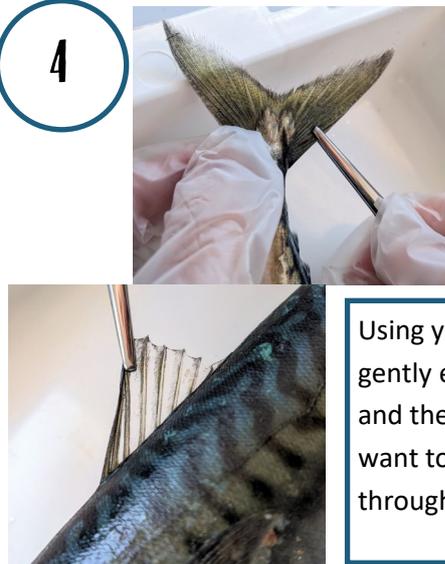
Carefully lift the gill flap and take a look underneath. What do you notice?

Note the colour and texture. The red colour is due to the many blood vessels. The large surface area helps with oxygen absorption.



4

Using your tweezers, gently extend the fins and the tail. You might want to look at these through a magnifier.



5



You can use tweezers to remove a scale then look through your hand lens or magnifier.

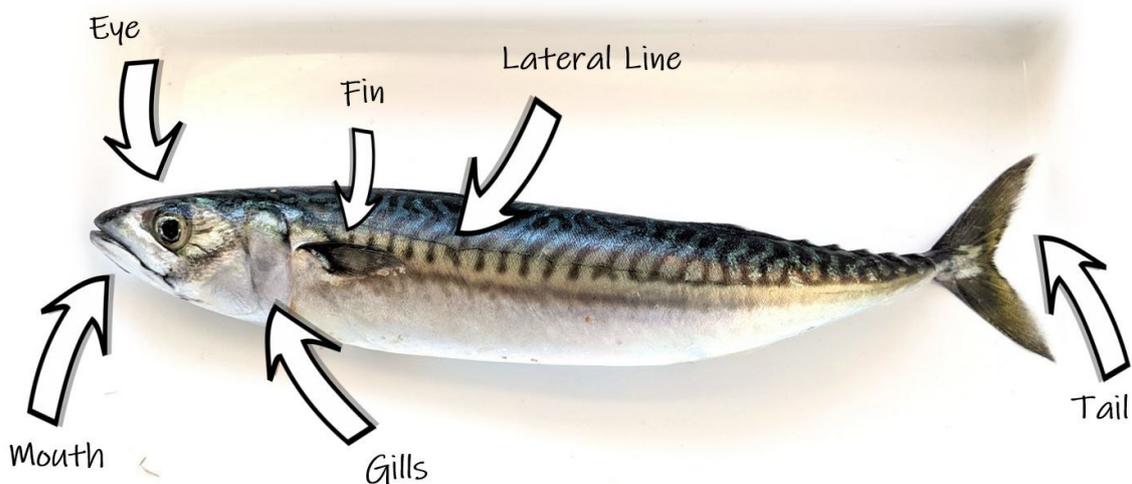
Scales grow with the fish and tiny lines on the scales can tell you how old the fish is!

6

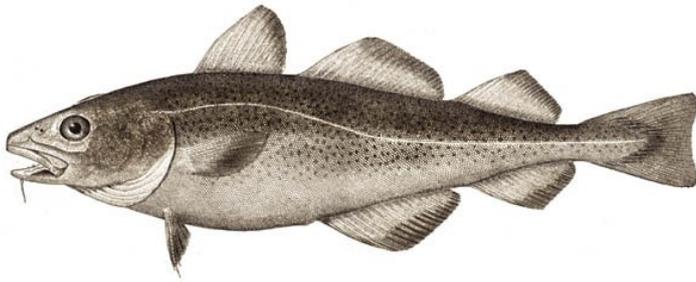


Optionally, you can use your knife to cut the belly of your fish. Cut from just under the gills to the tail. Once you have done this you can look inside the fish. Try to spot the swim bladder, which helps the fish float.

Finally, why not try and draw your fish, labelling it like the one shown on page 4 of this pack.



FISH AND SHELLFISH



Atlantic cod

GADUS MORHUA

SIZE:

Up to 120cm long

LOCATION:

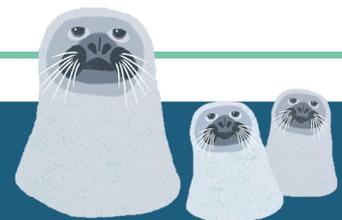
Widespread in UK waters

WHAT DOES IT LOOK LIKE?

Cod are yellowish-green and have darker spots which make them appear brown. Their undersides are pale with no spots and they have a white line along their bodies. Atlantic cod have two anal fins and three dorsal fins. Atlantic cod can be recognised by the 'barbel' which hangs down from their chin, like a long, thin whisker.

FACTS:

- ◆ Atlantic cod live in large shoals, this means they are a popular fish for fishermen.
- ◆ Though adult cod live in deep seawaters, young Atlantic cod prefer shallower waters around seagrass beds.
- ◆ One record-breaking female Atlantic cod was found to have 9 million eggs.
- ◆ Once thought to be inexhaustible, stocks of Atlantic cod have declined significantly in many areas. However, it remains a commercially important species. In 2020, by weight, cod was the fifth most landed species, and the third most valuable, in the UK.
- ◆ Cod is the type of fish most frequently sold in fish and chip shops in the UK.



FISH AND SHELLFISH



Atlantic herring

CLUPEA HARENGUS

SIZE: Up to 40cm long

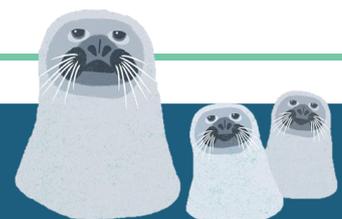
LOCATION: Widespread in UK waters

WHAT DOES IT LOOK LIKE?

With an overall silver appearance, the Atlantic herring features a darker blue iridescence over the upper half of its body. The underside is paler. This fish has a streamlined shape with a deep body. The tail is forked and there is a single dorsal fin. The pelvic fins are situated slightly in front of the line of the dorsal fin.

FACTS:

- ◆ Atlantic herring can form enormous shoals or schools. Vast near-surface shoals can cover an area of several square kilometres. They feed on plankton.
- ◆ Once the mainstay of many North Sea and North Atlantic fishing communities, these fish were known as 'silver darlings'.
- ◆ In the 20th century, excessive fishing led to the species' steep decline. Today stocks are managed (i.e. total allowable catch is set for the stock and countries agree their amounts).
- ◆ Herring is one of the very best food sources of vitamin D. Although our bodies make this vitamin using the sun's light, it's easy not to get enough this way if you have low exposure to sunlight.



DISCOVER

FISH AND SHELLFISH



Photo by [John Cameron](#) on [Unsplash](#)

Atlantic salmon

SALMO SALAR

SIZE: Up to 150cm long

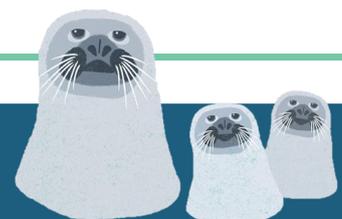
LOCATION: Widespread in UK waters

WHAT DOES IT LOOK LIKE?

Atlantic salmon actually change colour! Their colouring depends on their age and where they are living. When in the saltwater of the sea, salmon are silver with hints of blue and green. They also have dark spots and have white bellies. However, when they are in freshwater, like rivers, salmon become brown with darker brown spots.

FACTS:

- ◆ Atlantic salmon are born in freshwater but then migrate to sea for their adult life. However, they return to where they were born to have young. They do this by using their sense of smell!
- ◆ Between 8,000 and 25,000 eggs can be released by a female in one season.
- ◆ Atlantic salmon are also known as the 'King of the Fish', due to their jumping abilities.
- ◆ Floating fish farms rearing Atlantic salmon are common on Scottish sea lochs but the intensive nature of these farms means they are a source of pollution (faeces, medicine and noise).



FISH AND SHELLFISH



Lesser sand eel

AMMODYTES TOBIANUS

SIZE:

Up to 20cm long

LOCATION:

Widespread in
UK waters

WHAT DOES IT LOOK LIKE?

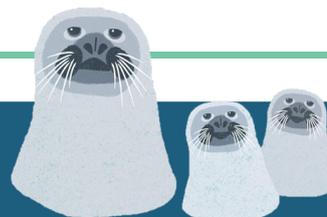
A long, thin fish with an overall silvery appearance, although it has yellowish-green and blue tints. The tail fin is forked and there is a single long dorsal fin. The lower jaw is longer than the upper jaw.

FACTS:

- ◆ Lesser sand eels are found from mid-tide level at sandy shores down to depths of 30 metres. During the winter they will bury themselves 20-50 cm deep in the sand.
- ◆ Between 8,000 and 25,000 eggs can be released by a female in one season.
- ◆ An important food source for Atlantic puffins, changing patterns in sand eel distribution due to ocean warming is a threat to puffin colonies. Sand eels are moving further north and to deeper levels which makes them difficult for surface feeders like the puffin to reach.



© Susan Davies



FISH AND SHELLFISH



Brown crab

CANCER PAGURUS

SIZE: Up to 30cm in length

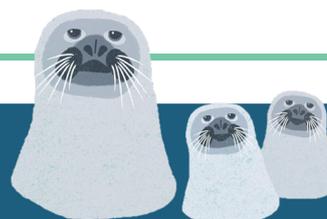
LOCATION: Around the British Isles in waters as deep as 100 metres

WHAT DOES IT LOOK LIKE?

The shell, which is also called a carapace, is oval-shaped with a scalloped edge which makes it look like a pie crust. Brown crabs are an orange-red colour and have 8 legs with 2 large claws. Brown crabs are also known as 'edible crabs' and are a highly valued luxury food.

FACTS:

- ◆ Brown crabs shed their shells as they grow.
- ◆ They are thought to live for around 40 years and could even live longer.
- ◆ You can often find young brown crabs in rockpools.
- ◆ Brown crabs breed all year round with females incubating their eggs for 7-8 months.
- ◆ Originally fished for in inshore areas, technology advances have enabled the fishery to expand to offshore areas, especially to the west and north of Scotland.



FISH AND SHELLFISH



Common lobster

HOMARUS GAMMARUS

SIZE: Usually up to 50cm in length but can be longer

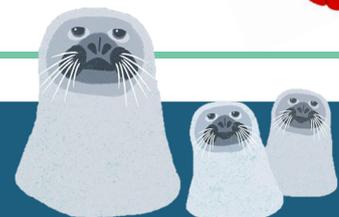
LOCATION: All around Scotland in waters up to a depth of 60 metres

WHAT DOES IT LOOK LIKE?

The Common (or European) lobster is blue-coloured on top (with small light-coloured spots) and yellowish underneath. The first pair of walking legs have massive pincers. These pincers are slightly unequal with the larger one used as a crusher and the smaller as a cutter.

FACTS:

- ◆ Lobsters are invertebrates, with a hard, rigid protective exoskeleton or shell. They grow in length by shedding their exoskeleton in a process known as moulting.
- ◆ The blue colouration of this lobster's shell is caused by a pigment in the exoskeleton called 'astaxanthin' (asta-zan-thin), which turns bright red when significantly heated. This is why a cooked lobster appears red.
- ◆ Commercially important, the Common lobster is in danger of exploitation because it matures slowly and does not reproduce until it is around six years old.



FISH AND SHELLFISH



Common mussel

MYTILUS EDULIS

SIZE: Usually 5-10cm long but can reach 20cm

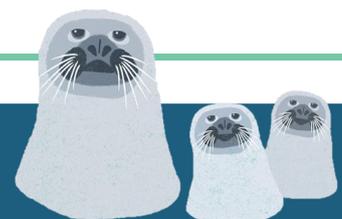
LOCATION: Very common around all Scottish coasts

WHAT DOES IT LOOK LIKE?

Dark bluish or purplish in colour, the shells are almost triangular in shape but with curved edges. Asymmetrical and concentric lines can be seen on the shell surfaces.

FACTS:

- ◆ Large, dense beds of mussels can form, with each mussel attaching itself to the seabed, and each other, using sticky fibres called byssus threads. These fibres are five times tougher than a human tendon.
- ◆ Mussels have been harvested for food around the world since early times and are a staple of many seafood dishes such as paella.
- ◆ Mussels have also long been used as bait. Fishermen can attach mussels to lines to catch a range of fish species.
- ◆ Common mussels are very efficient filter feeders—processing up to 70 litres of water per day and eating almost everything that they trap.



FISH AND SHELLFISH



European native oyster

OSTREA EDULIS

SIZE: Up to 11cm in length

LOCATION: Upper and middle shore

WHAT DOES IT LOOK LIKE?

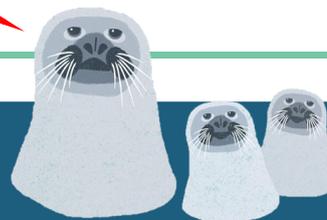
The two shells of the native oyster are oval or pear-shaped with a rough, scaly surface. The shell is yellowish-cream colour with light-brown concentric bands.

The inner surfaces of the shells are pearly white with some darker areas. The shells you find on the beach will likely be well-worn and smooth.

FACTS:

- ◆ Oysters are born male but change between male and female throughout their lives. Each adult female can produce around 1 million larvae per year, although only a few survive to become adults.
- ◆ Charles Darwin used oysters from the Forth in his experiments at the University of Edinburgh, which contributed to the development of his evolution theory.
- ◆ The oysters harvested near Prestonpans were said to be the finest. Known as 'pandores' their superior flavour was thought to result from the salty water flowing out from the 'pan doors' of the salt works.

**Learn more about oysters in
our blog on the next page...**



AWESOME OYSTERS

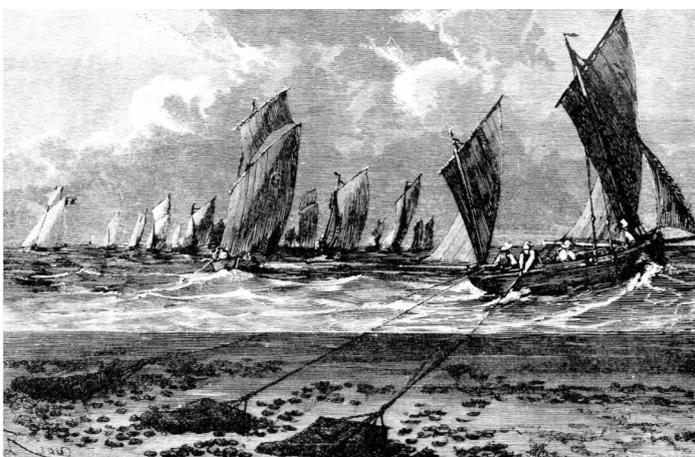


Much more than a simple source of food, the oyster has become deeply embedded in our history and culture, as have the people who caught and sold them. Oysters can also have a positive impact on the habitat in which they live.

In the past, the Firth of Forth had native oyster beds covering an area the size of present-day Edinburgh. Two centuries ago, it was Scotland's most important oyster fishery with 30 million oysters harvested each year. As a cheap and plentiful food, oysters were accessible to all sections of society. Oyster fishermen would sing songs to charm the oysters into the dredging nets and help them keep time when rowing. Oyster sellers would stand on street corners shouting "Caller Ou", meaning "fresh oysters".



1855 Song sheet illustration of a Scotch Ballad by Edinburgh composer R. Roy Paterson



Vessels dredging for oysters 1870s, public domain

However, in an effort to meet demand both at home and further afield, Forth oysters were over-exploited. Short-term profit was put before the longer-term management of oyster stocks. This, coupled with the pollution of the industrial age, sent oysters from abundance to rarity. Catches dramatically declined and by 1900 oyster fishing on the Forth had effectively ended.

AWESOME OYSTERS



Oysters available to eat today in Scotland tend to be farmed, as part of the growing aquaculture sector. However, rather than being the native variety, farmed oysters tend to be of the Pacific oyster species. These oysters are cultivated in cages at licensed oyster farms.

The native oyster (on the left) is flatter and smaller than the Pacific oyster (on the right). The native grows more slowly and is seasonal while the Pacific is available to eat all year round.



However, the loss of native oyster population is significant not just in terms of food production but due to the other benefits that those native reefs provided. By forming reefs, oysters provide safe habitats for other species. Crabs, fish and sponges can find shelter and food there. The 'ecosystem services' provided by oysters around nutrient cycling, water filtration, habitat structure and food web dynamics also ceased.

[The Restoration Forth project](#) will offer a second chance to the Forth's lost habitat. By looking at where native oysters were located historically and overlaying current seabed use, the project will identify areas which minimise conflict with industrial and recreational users and maximise the chance of successfully restoring this important species. Working hand-in-hand with nature offers the best hope for healthy seas in the future.





QUIZ

CHECK WHAT HAVE YOU LEARNED

- 1 How many fish species are there in the world?
- 2 Name the 3 different groups of fish.
- 3 Where does a demersal fish live?
- 4 What is the name for the special cells on the side of a fish's body?
- 5 What does a swim bladder help with?
- 6 When would a mollusc be considered a bivalve?
- 7 How many MPAs does the UK have?
- 8 What certificate should you look for when shopping for fish?



OVERVIEW

FISHERIES MANAGEMENT



Fish and shellfish are an important part of the human diet, accounting for a worldwide average 15% of humans' protein intake. Once seen as a vast resource that would never run out, we now know that many fish stocks have collapsed. Efforts to protect fish, shellfish and their habitats have to overcome many challenges.

It is difficult to police fisheries on the high seas all around the world. Controlling fishing in one area can be tricky if it is less controlled in a neighbouring area. Illegal fishing activity is common in some places. Some fishing methods also create high levels of waste with many species being discarded.



As seafood is Scotland's second largest export, the Scottish government wishes to maintain the long term sustainability of Scotland's marine fisheries. **Marine Scotland** (which is a part of the Scottish Government) is the body that should help make sure that fishing in Scotland is **sustainable** by placing controls around the activity of all fishing vessels operating within Scottish waters.

Marine Scotland's role in relation to fisheries includes:

- ◆ Licensing of fishing vessels
- ◆ Setting catch limits
- ◆ Minimum standards for the way that fishing activity is carried out
- ◆ Monitoring of fishing vessels while at sea
- ◆ Controls on landing, sale, purchase, transport and traceability of sea fish



Scottish Government
Riaghaltas na h-Alba
gov.scot

marinescotland





OVERVIEW

MARINE PROTECTED AREAS

WHAT IS A MARINE PROTECTED AREA?

Marine Protected Areas (MPAs) are parts of the sea where activities that damage the habitat are banned. These designated areas may have controls and/or limits on certain levels of activity to allow nature to thrive. In the UK, we have 371 MPAs which cover around 38% of the sea. Some of these areas are HUGE, with the West of Scotland MPA being bigger than Scotland!

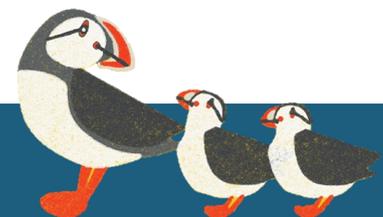


HOW DO MPAS HELP FISH?

Though fishing is not banned in most UK MPAs, it should be appropriately regulated with monitoring to ensure compliance. There is often a limit on how many fish are allowed to be caught and the method of fishing is also controlled. By protecting the habitat within an MPA, there is often an increase in fish, and improvements in biodiversity, which in turn should lead to healthier and more productive seas which will benefit fishing communities. The areas of sea outwith the MPA boundaries also benefit as the healthy fish stocks spread out to nearby waters and increase the biodiversity there too.

FISHING BAN

Some areas of the sea are sometimes closed to fishing. This is usually to allow younger fish to become adults, so they can **reproduce** and keep fish numbers up. Sustainable fisheries improve the health of fisheries because the number of fish that are caught and killed does not ever exceed the birth of new fish.





GUIDE

TO EATING FISH SUSTAINABLY

WHAT FISH CAN I EAT?

When you buy fish from the supermarket or a restaurant it is important to know that you are buying products which have been sourced sustainably. Even if a fish species is not vulnerable it can have many different populations, some of which may be more threatened than others. It can therefore, be tricky to know what is the best fish to buy.



MARINE CONSERVATION SOCIETY

The Marine Conservation Society has a Good Fish Guide, which tells you what fish you should eat and what to avoid. It uses a traffic light system, which is updated at least every 3 years. This fish guide covers about 130 species and can be accessed [online](#) or via their app.



THE MARINE STEWARDSHIP COUNCIL

The Marine Stewardship Council provides certificates to fisheries which are sustainable. To know if you are purchasing a fish that has been harvested from a sustainable fishery you should look for this blue label. This label can be found on supermarket packaging or displayed in restaurants and fish stores.



FUN TASK!

You could go to your local supermarket and see what fish and shellfish species are being sold and see if you can find the MSC blue label.





QUIZ

ANSWERS

- 1 How many fish species are there in the world? **Over 30,000 species**
- 2 Name the 3 different groups of fish. **Bony, jawless and cartilaginous**
- 3 Where does a demersal fish live? **On the seafloor**
- 4 What is the name for the special cells on the side of a fish's body? **The lateral line**
- 5 What does a swim bladder help with? **Buoyancy; not sinking; moving up and down**
- 6 When would a mollusc be considered a bivalve? **When it has a pair of hinged shells**
- 7 How many MPAs does the UK have? **371**
- 8 What certificate should you look for when shopping for fish? **Marine Stewardship Council**

DISCOVER

GLOSSARY

ADAPTED	When an organism becomes better suited to its habitat through evolutionary process.
BIVALVE	A type of mollusc (such as an oyster, mussel or scallop) which has a compressed body enclosed within a hinged double shell.
BUOYANCY	The ability of something to float or rise when submerged in a liquid.
CAMOUFLAGE	When animals conceal themselves by blending into their surroundings, either by the pattern, colour or texture of their skin, or the use of materials around them.
DEMERSAL	Living close to the floor of the sea.
EXTINCT	When a species has disappeared from the planet. There are no more alive.
INVERTEBRATE	An animal without a backbone.
LOCOMOTION	Directional movement that allows something to move from one place to another.
PLANKTON	Plants or animals unable to swim against a current, meaning they have no control over where they are taken around the world. Plankton are mostly microscopic in size but some larger animals, such as jellyfish, are classed as plankton too.
PELAGIC	Relating to the open sea, rather than the floor of the sea or the shore.
PREDATION	The process when an animal hunts another animal for food.
REPRODUCE	To create a new living thing, such as a baby.
SUSTAINABLE	Use of resources in such a way that they will not run out or become too scarce.
VERTEBRATE	An animal with a backbone or spinal column—for example mammals, birds, reptiles, amphibians, and many species of fish.