

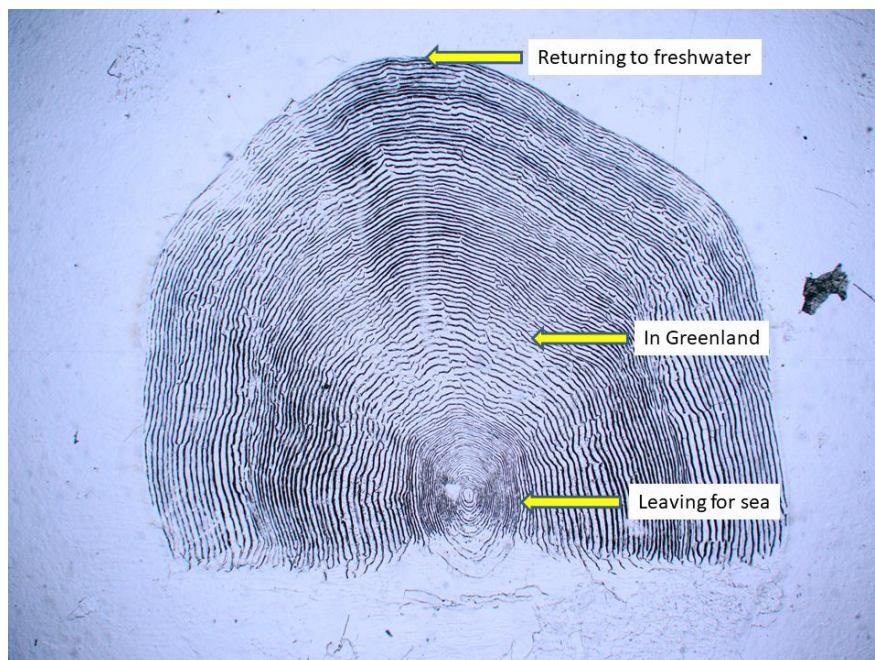
Case Study : Salmon

The salmon is a diadromous fish – one that lives both in fresh and sea water at different points of its lifecycle. As such, it is particularly sensitive to changes in river or sea conditions that may influence its spawning and foraging grounds, migration routes or exposure to diseases and predators.

Scientists working for Marine Scotland at their laboratory at Faskally are undertaking extensive research into salmon. They have kindly shared their research and materials with us for the exhibition.

Salmon Scales

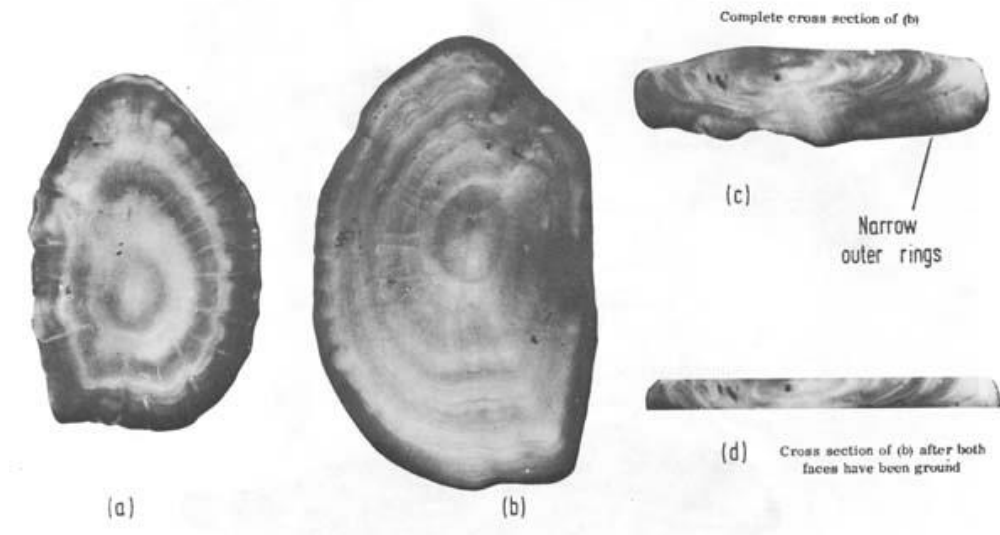
Scientists can learn a huge amount about the life history of a salmon from its scales.



Each scale grows continuously, creating a record of the life events that the fish has experienced. By analysing the growth rings, it is possible to find out the age of the fish, when it entered the sea, how fast it grew and even when it spawned.

Salmon Otolith

Like all vertebrates, salmon have a tiny *otolith* in their inner ear which aids balance, movement and hearing.



Sampling otoliths at a fish market

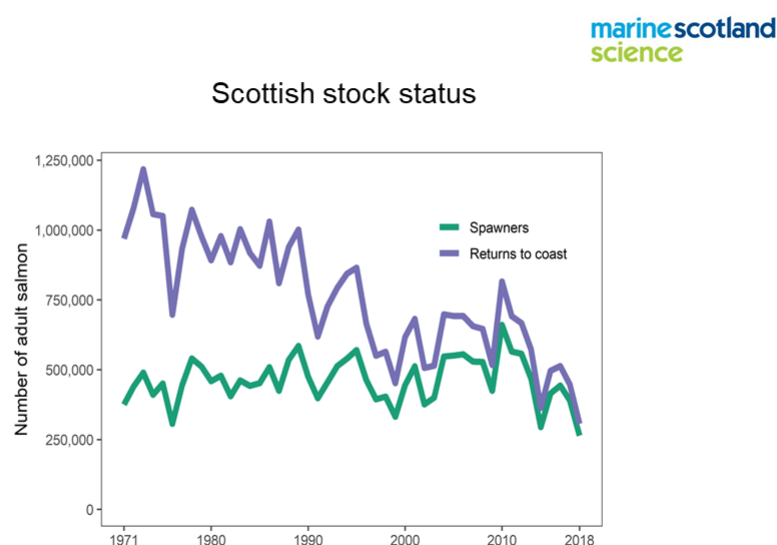
The otolith is made of calcium carbonate and, like a fish scale, grows continuously creating growth rings. It also carries a record of the chemical composition of the water and can be analysed to estimate the water temperature experienced by the fish during its marine migration. Comparing this data with known sea temperatures in the North Atlantic allows scientists to map the possible migration route of the fish.

Analysing scales and otoliths gives us an intimate picture of the factors affecting individual fish and, by comparing the results with historical samples, can show us how general fish health, growth rates and behaviour are changing over time.

These results can then be compared with knowledge of external pressures, both localised and more widespread, to understand why any changes may be happening. Then using models, we can hope to predict how issues such as climate change might impact salmon in the future.

Declining Salmon Numbers

Numbers of salmon returning to Scottish rivers have decreased progressively in recent decades. Until recently, the numbers of salmon spawning have been more stable due to reductions in the numbers taken by fisheries, including coastal nets.



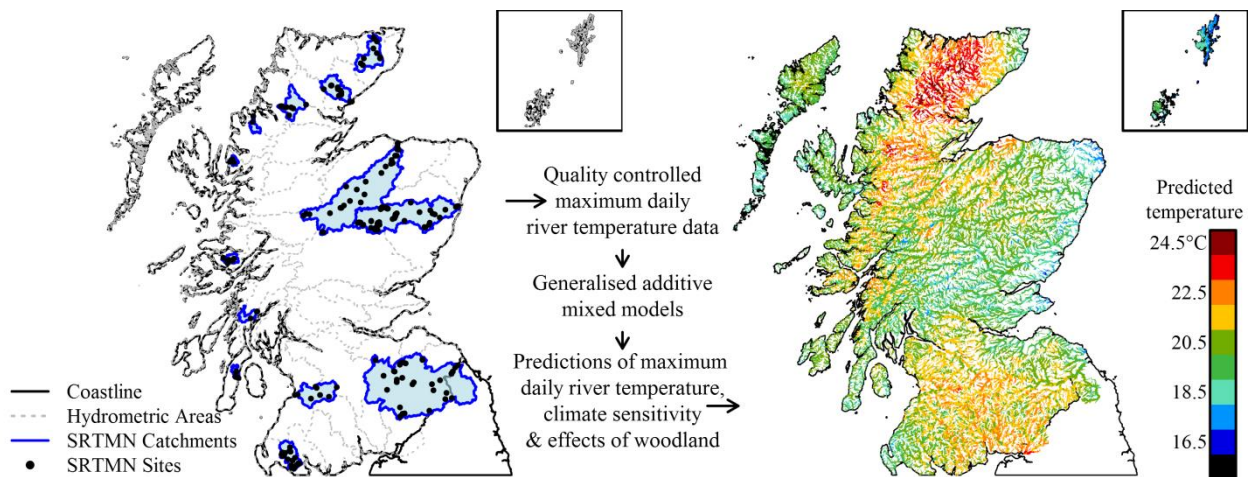
Coastal net fisheries were stopped altogether in 2016 and anglers now return more than 85% of salmon caught. However, despite these reductions in exploitation, numbers of spawning salmon have now also started to decline.

The trend in Scotland mirrors international data for North Atlantic Salmon pointing to common problems, potentially including climate change. It is likely that something is happening in the sea which is making it harder for salmon to return to spawn. If we want to stop the decline, fisheries managers will need to take action on the problems that have already been identified and more research will be needed to identify less well understood drivers of change.

River Temperatures

As salmon spend part of their lifecycle in rivers, there is concern that rising river temperatures linked to climate change could have harmful effects.

Young salmon show thermal stress and changes in behaviour where river temperatures are above 23°C. Even smaller increases in temperature can reduce growth. Temperatures above 33°C can kill young salmon in as little as 10 minutes.



Since 2013, the Scotland River Temperature Monitoring Network has measured river temperatures at over 200 locations. The data collected has been used in statistical models to predict water temperatures for all of Scotland's rivers to identify where salmon are at most risk.

Temperature Gauge



This Tinytag TG-4100 temperature logger contains a thermometer, battery and data recording device. There are over 200 of these loggers in Scottish rivers recording temperature every 15 minutes. They can do this for around 340 days before running out of memory. That's around 32,000 temperature values in one logger!

Plant a Tree to Save a Fish!

Planting trees is a good way to reduce carbon in the atmosphere but did you know it can also help to support salmon and sea trout?

Hotter summers are causing increased river temperatures across Scotland. However, carefully placed and chosen bankside trees can provide shade, reducing the amount of sunlight (solar radiation) reaching the water, and thus river temperatures. The benefits of planting are greater in medium-sized rivers that are shallow and wide and orientated to receive the most sun.

Increasing the amount of trees on river banks can reduce some of the effects of climate change. Maps of where river temperatures are hottest and most sensitive to climate change (i.e. will change the most) are useful tools to help river managers plant trees where they give the greatest benefits. Research is ongoing to further develop these tools.



Find out more about the work of Marine Scotland at their blog:

<https://blogs.gov.scot/marine-scotland/>