



The
University
Of
Sheffield.

The Story of Sheffield's Salmon

Ecologists from the University of Sheffield join environmentalists from the Don Catchment Rivers Trust to tell the story of the River Don's Atlantic Salmon, and how pioneering research could help us track the recovery of this iconic species.



Created for the Festival of the Mind 2020 by the Salmon of Steel team.

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The "Story of Sheffield's Salmon" is available to listen as a podcast on Podbean -

<https://festivalofthemind.sheffield.ac.uk/2020/spiegeltent/salmon-of-steel-story-podcast/>

Few species evoke images of pristine rivers more than the salmon does. It's a staple of nature documentaries, usually scaling waterfalls and narrowly avoiding the jaws of a grizzly in the wilds of North America. It therefore often surprises people in South Yorkshire when they learn that the River Don once sustained a huge salmon population.

Salmon spend their early life in rivers like the Don, before migrating out to sea and travelling to their feeding grounds in the North Atlantic. After one or more years at sea they make an amazing journey, homing back to historical spawning grounds where they females make nests (called redds), lay their eggs in the gravel and males fertilise them.

In recent decades a remarkable recovery of the River Don has got underway, largely due to improvements in water quality resulting from the decline and regulation of heavy industry and improved treatment of sewage. While many water quality issues still remain, the fact that salmon's relatives, trout and grayling, are now doing well in the Don shows that the water is clean enough for salmon too.

So how do you get salmon back to the River Don? Well salmon have been attempting to migrate up the Don for a number of years, and have been observed jumping in vain to ascend barriers on the lower half of the river. You may be wondering why salmon are swimming up the Don when their homing instinct should lead them back to where they were born. The reason is that their "internal satnavs" can make mistakes, and some individuals end up straying into different rivers.

For over 200 years, Sheffielders have missed the sight of Salmon jumping in the City of Steel. But is the tide turning. Hi I'm Ed Shaw and I am the Director for the Don Catchment Rivers Trust - currently standing at Sanderson's weir on the river Don.

To help salmon return to the Don various organisations including the Don Catchment Rivers Trust, Environment Agency, Yorkshire Water, and others have worked to create a migration 'superhighway' by installing fish passes on the barriers that were obstructing salmon.

Excitingly, early indications suggest that the Don's migration superhighway is already beginning to work, with two salmon being found in Sheffield in January 2019, the first records of salmon in Sheffield for over 200 years. What's more, examination of one of these fish showed that it had spawned.

However, the job is not yet done as the best spawning habitat for salmon is upstream of Sheffield, and we want salmon to continue up the Don. There are, however, many more barriers upstream of Sheffield that have not yet been addressed. These barriers are not impossible for salmon to pass, rather they obstruct salmon to varying degrees, leaving us unsure of how far salmon are getting up the Don. This is where the University of Sheffield's research comes in.

Hello I am Deborah Dawson. In our laboratory, at the University of Sheffield, we use DNA profiling to study wildlife. We investigate things like mating systems, territory sizes, population genetics and diet and we use a wide range of sample types, such as feathers, hair or even poo. We are also able to take water or soil samples and either screen for certain species or identify all of the multiple different species present. This allows us to, for example, test ponds for the presence of the great crested newts or identify all the different fish species in a lake.

These new technologies of using environmental DNA (or eDNA, such as water or soil) allows us to detect species that are hard to study. This might be because they are elusive or nocturnal or they might be rare species, present in very low numbers or with big territory sizes, making them hard to track down.

This method of using a water or soil sample limits disturbance to the animals and can be used to study the whole ecosystem. We can detect species that are indicators of clean water such as brook lamprey or caddisflies or monitor invasive species that damage ecosystems such as signal crayfish or killer shrimp.

In 2019, in collaboration with the Don Catchment Rivers Trust, Environment Agency and Yorkshire Water we started the Salmon of Steel project, an exciting new study to detect salmon on the River Don. Our aim was to try to work out how far upstream salmon had travelled and whether they had reached their historical spawning grounds upstream of Sheffield. If we can identify barriers to their passage, we can focus on how to overcome these. Having beautiful salmon leaping again in our rivers would benefit the whole ecosystem and show us how far the River Don has come on its long road to recovery. Paul tells us more about the Salmon of Steel project.

Hi, my name is Paul Parsons I am one of the Researchers at the University of Sheffield working on the project. You find me here on the bank of the river Don in the middle of a cold Winter collecting river water samples.

Salmon return to inland rivers to breed in late autumn and early winter, so we have focused our river water collection around these dates. During their journey Salmon shed scales, defecate and produce eggs or sperm which releases their cells into the river. Some individuals may even die during their attempts to reach their spawning grounds or after spawning, spreading many cells into the water as the bodies decompose. All of these cells contain DNA specific to Salmon.

With modern genetic techniques we can collect and process this DNA within a river water sample and test for the presence of this Salmon DNA signature. If we find Salmon DNA in our samples we will have good evidence that Salmon are back swimming in the Don.

So we start this process by collecting a water sample, which is as simple as filling a sterile bottle with river water from the bank. We then take it back to the lab for processing. So let me take you into the lab now.

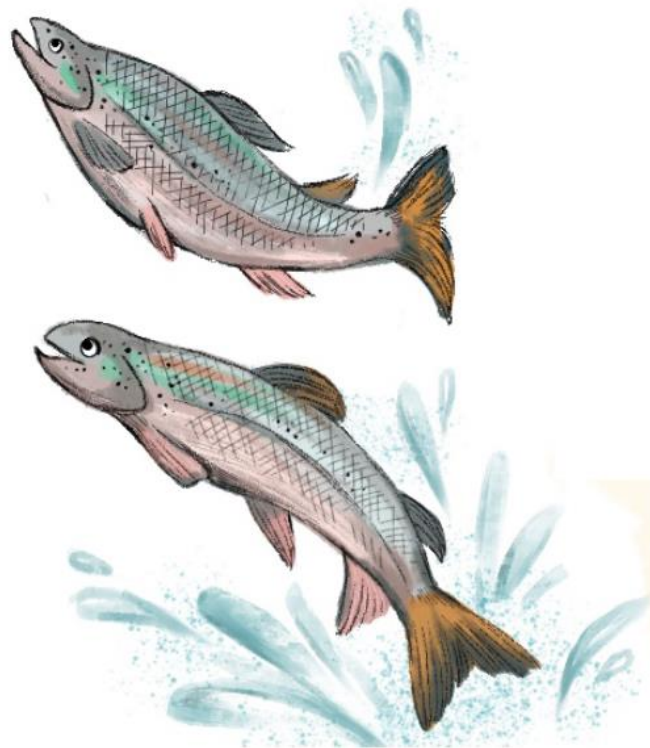
Here we pump our litre of river water through a fine filter. The size of the pores in the filter are so small, they trap cells from all the creatures living in the river - fish, aquatic insects, plants or even your own Human DNA if you go for a paddle. We then carefully wash the DNA off the filter and concentrate it, ending up with a soup that contains a mixture of all sorts of creatures' DNA that hopefully includes our Salmon!

Hello, my name is Sara and I came to Sheffield from Portugal for 6 months to share my experience on molecular techniques to study species from water samples. This knowledge exchange grant was provided by the European Union and allows development and sharing of new techniques to benefit many studies across different universities.

After the extraction of the DNA from the river water, we screen the DNA soup for the presence of Salmon, using a special molecular probe that only sticks to Salmon DNA. To make sure we didn't get any false results, we first checked the probe didn't stick to any other of the fish species in the River Don and confirmed the probes only stuck to Salmon DNA.

Using this species-specific probe-based method, we successfully detected Salmon DNA in the River Don at 7 sites sampled in 2019. We hope to sample more sites when Salmon next visit in Winter 2020 to track how far upstream salmon have reached and try to identify blockages to the salmon's migration. This will allow us to focus conservation efforts and resources on specific sites, improve river connectivity and hopefully lead to increases in salmon numbers in the future.

The recovery of the Don Catchment's salmon population would be welcome news, as the global outlook for the species is less rosy. In recent years there has been a range-wide decline in the abundance of Atlantic Salmon. The causes are not well understood, though it is thought that climate change is disrupting oceanic feeding grounds, and the fish farms are putting a heavy burden on wild salmon through the parasites and diseases they release into the sea. All the more reason then to cheer the return of salmon to the Don, and to strive to give the species the best possible chance and maybe one day even flourish again in the river.



THE END

This transcript is available to listen as a podcast on Podbean
<https://festivalofthemind.sheffield.ac.uk/2020/spiegeltent/salmon-of-steel-story-podcast/>

Festival of the Mind – Steel City River Walk

We have created the “Salmon of Steel Trail” with an accompanying podcast including stories of Sheffield. This walk along the river and canal through the centre of Sheffield takes travellers from Kelham Island Museum to Sheffield Station. See the map on the following page.

Download the **Steel City River Walk Trail map** and associated **podcast** here -
<https://mk0festivalofthw28id.kinstacdn.com/wp-content/uploads/sites/2/2020/09/FINAL-MAP-Salmon-of-Steel-Trail-2020.pdf>

<https://festivalofthemind.sheffield.ac.uk/2020/spiegeltent/salmon-of-steel-city-river-walk-podcast/>

Most **salmon** will migrate up the River Don in the months of October, November and December to breed. If successful young salmon may be seen in the river throughout the year, feeding and growing before they make the journey out to sea. Have you spotted a River Don salmon? Go to www.dcrtr.org.uk and get in touch.

Why not follow the trail all the way to Sheffield Railway Station to see the **Salmon of Steel** sculpture, created by local Scrap Metal Artist Jason Heppenstall.

Download the **'Salmon of Steel'** podcast on Podbean and listen to it along the trail.

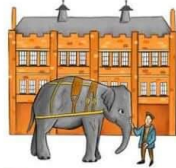
Illustrated by Sophie Carter.

Full route Approx 2 hours walk: - - - -
Short route Approx 1 hour 30-minute walk: - - - -

The trail is accessible and cyclable, but take care on the unpaved surfaces and narrow paths.



1 We start our journey at **Kelham Island Museum**. This building was once a powerhouse for Sheffield, generating electricity for the city's tram network. But, long before electricity, the river was used to fuel Sheffield. **Weirs** were built across the river to harness the power of the water and turn watermills, first milling corn but later used to power the machinery that helped to produce Sheffield's famous metal work. Look for the weir spanning the river and the 'Goit' that channels the water beside you, creating the Kelham 'island'.



2 We've arrived at **Lady's Bridge** and another weir... but can you hear that rumbling sound? Sheffield steel was vital to the war effort during World War One, but with horses sent to the frontlines, who would pull the heavy loads of machinery and steel? The glazed orange building above you once housed an elephant called Lizzie, who did just this.



6 But as the clock turns forward new life is breathed into the river. A sewage treatment works is built, polluters are fined for the damage caused, and as time passes industry declines. Can you believe that you are now standing on the site of an old industrial factory?

This is **Salmon Pastures**, now one of the wildest and most beautiful spots along the river. Riverflies emerge from the water, snapped up by greedy fish. The fish are caught themselves by hunting heron, kingfisher and even otter. Life has returned to the Don.



5 **Splutter!** I can hardly breathe in this industrial fog and smoke. Decades of **pollution** and misuse meant that throughout the 1900s the Don was in a sorry state. Bright yellow in colour, it was filled with toxic chemicals, oils and the city's filth. Who will hold these polluters to account!

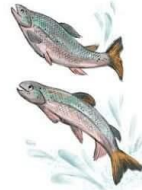


3 Look across the river. **Sheffield Castle** once dominated the skyline here, defended from attackers by the river's power. Later, when the castle was in ruins, this spot became a bustling **market place**. The River Don was rich in salmon, trying to migrate upstream to their spawning grounds but blocked by the steep, stone weirs. Cone-shaped traps called 'hecks' were placed on weirs to catch them as they tried to leap over. So many were caught, salmon meat sold at the market for as little as two pence per kilogram.



4 Hold your nose... a **Victorian toilet** hangs over the river just there. Booming industry meant booming populations of workers. Pollution from industry flowed into the river, but more damaging was the untreated sewage from the growing workforce. The river became almost devoid of life, but what is that growing there in the murk... a seedling? The river became tropically hot from the dumping of hot industrial water, providing the perfect conditions for fig seeds in the sewage to germinate, creating Sheffield's own forest of **fig trees**. Take the riverside footpath until you reach the **cobweb bridge**. This is the only route across to the other side so cross the cobweb carefully, avoiding the spider's watchful eyes above you.

TO THE RAILWAY STATION



7 **SPLASH!** Could it be? A huge fish jumps and dives in the water below the weir. Can you see her? It's the stuff of legend - an **Atlantic Salmon**. One of the first few to return in two hundred years. She's followed her nose all the way from the ocean to our river, searching for the perfect conditions to lay her eggs. But this **HUGE** weir blocks her path. **SPLASH!** Water tumbles down a **fish pass** built especially for her to cross over. She swims up the watery escalator with ease and continues her migration.

8 This peaceful **cemetery** is the last resting place for many of the mill and steel workers that lived along the Don during the industrial boom. Would they recognise the River Don today?



9 Imagine through the smoke and fog, a strong shire horse plodding up the **tow-path**, pulling a barge brimming with goods. The **canal** was built to help transport Sheffield's goods across the UK, to seaside ports and then across the world. Listen out for a train crossing the bridge ahead. The invention of the faster, powerful steam engine quickly replaced the canal boats. We'll follow the canal down to the **Victoria Quays** and the end of our journey.



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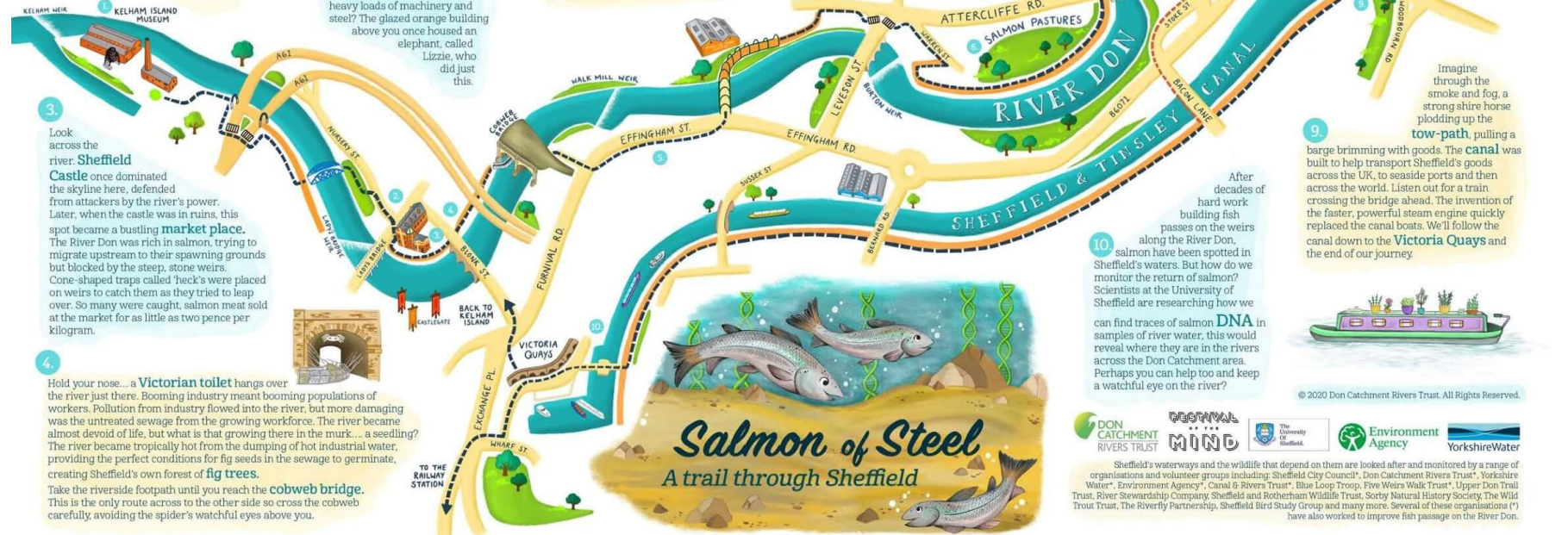
After decades of hard work building fish passes on the weirs along the River Don, salmon have been spotted in Sheffield's waters. But how do we monitor the return of salmon? Scientists at the University of Sheffield are researching how we can find traces of salmon **DNA** in samples of river water, this would reveal where they are in the rivers across the Don Catchment area. Perhaps you can help too and keep a watchful eye on the river?



Sheffield's waterways and the wildlife that depend on them are looked after and monitored by a range of organisations and volunteer groups including: Sheffield City Council, Don Catchment Rivers Trust, Yorkshire Water, Environment Agency, Canal & Rivers Trust, Blue Loop Troop, Five Weirs Walk Trust, Upper Don Trail Trust, River Stewardship Company, Sheffield and Rotherham Wildlife Trust, Sooty Natural History Society, The Wild Trout Trust, The Rothery Partnership, Sheffield Bird Study Group and many more. Several of these organisations (*) have also worked to improve fish passage on the River Don.

Salmon of Steel

A trail through Sheffield





Salmon of Steel sculpture by Jason Heppenstall at Sheffield Station

Further information:

Festival of the Mind – The Story of Sheffield’s Salmon podcast

<https://festivalofthemind.sheffield.ac.uk/2020/spiegeltent/salmon-of-steel-story-podcast/>

Festival of the Mind – Salmon of Steel project

<https://festivalofthemind.sheffield.ac.uk/2020/protopia/salmon-of-steel/>

Festival of the Mind – Steel City River Walk podcast

<https://festivalofthemind.sheffield.ac.uk/2020/spiegeltent/salmon-of-steel-city-river-walk-podcast/>

University of Sheffield - Salmon of Steel Research project

https://www.sheffield.ac.uk/molecol/deborah-dawson/salmon_of_steel

Don Catchment Rivers Trust (DCRT)

DCRT work to protect and restore the rivers of the Don catchment.

<https://dcr.org.uk/>

Don Catchment Rivers Trust – Salmon of Steel Festival of the Mind webpage

<https://dcr.org.uk/salmon-of-steel>

Don Catchment Rivers Trust

Video - The historical significance of salmon in Sheffield by Sally Hyslop.

<https://www.youtube.com/watch?v=iK5MiKd3uBE>

Don Catchment Rivers Trust –

Video - Building the Hadfield weir fish pass, Sheffield.

<https://www.youtube.com/watch?v=nXSaIKCiHG4>



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