A New Chemical Method for Distinguishing Between Farmed and Wild Salmon

Wild salmon and farmed salmon can now be distinguished from each other by a technique that examines the chemistry of their scales.

Dr Clive Trueman, who is based at the National Oceanography Centre, Southampton, said: "Salmon farming is a big, intensive business. In 2006, around 130,000 tonnes of salmon were farmed in Scotland for the table. Wild populations of Atlantic salmon are in serious decline across their whole range and the total wild population returning to Scottish rivers in the same year is estimated at less than 5000 tonnes. Wild fish are rare and expensive so there is a strong incentive for fraudulent labelling. Farmed fish also escape into rivers, harming the wild population. Unfortunately, it can be difficult to distinguish between farmed and wild fish."

This new work, done in collaboration with the Scottish Association for Marine Science (SAMS), Oban, will help to crack this problem.

Fish scales are formed from the same chemicals as bones and teeth and grow like tree rings, preserving a chemical record of the water the fish lived in throughout its whole life. Scales are easy to collect, and can be removed from fish without harming them – which is important when studying an endangered population. The team discovered that levels of the trace metal manganese were always much higher in fish of farmed origin.

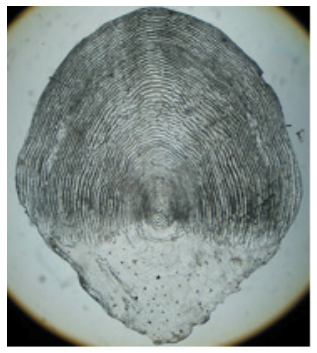
"This is probably caused by manganese supplements in fish food, and also because conditions underneath the fish cages promote recycling of manganese in the water column," said Dr Elizabeth Adey from SAMS, lead author on the research.

Using relatively simple techniques, the team was able to distinguish between farmed and wild fish with 98% accuracy.

Dr Truman explained: "The method was essentially based on a simple acid digestion of the scale, then analysis for trace element concentration by solution-based ICP-MS. Our initial tests showed that by taking a standard additions approach to instrument calibration, we could get reliable analyses of around 20 metals.

We then took around 300 scales from fish from farms spread across the west coast of Scotland and the Scottish Islands, and a similar number from fish caught wild in Scottish rivers (again spread around the coast of Scotland). Mn content alone distinguished these fish with 98% accuracy (assessed by discriminant function analysis). Adding additional elements didn't improve the classification significantly, although lithium may give some useful additional separation.

"Mn levels are always higher in the farmed fish regardless of farm origin, or river origin (for the wild fish). We suspect that this reflects Mn supplemented to the fish pellet feed, and recycling on Mn in anoxic sediment conditions that are established under salmon cages. So the practical application is that you can simply measure Mn content in scales, and distinguish between farm origin and wild origin fish.



Fish scale showing growth rings

This is important, as the wild fish are now really rare in many rivers, so you need a non-destructive test that doesn't harm the fish. Removing a scale doesn't harm the fish, so it's a method that can be applied on endangered stocks. We need to know how many farm escape salmon are in a river because they can interbreed with the wild stock and reduce fitness. That can seriously impact the number of surviving fish, and other workers have estimated that where salmon farms are operating in the same areas as wild stocks, the wild stocks have been depleted by at least 50%.

"Because of its non-destructive nature, this technique could be used to assess the proportion of farm escape salmon present in any river, and therefore identify where additional conservation and wildlife protection measures are needed," said Dr Trueman, a Geochemist with the University of Southampton's School of Ocean and Earth Science, based at that National Oceanography Centre.

Concern over declining numbers of wild Atlantic salmon has led to the closure of most fisheries, and the growth of salmon farms has been implicated in the decline of the wild fish. In 2000, more than 400,000 fish escaped from farms in Scotland. This is a problem as farmed salmon are not adapted to the local environment, and if they breed with the wild stock, the resulting offspring are less likely to survive to adulthood.

In some years, the number of fish that escape from farms in Scotland is close to the total number of wild fish, and in marine feeding grounds almost half of all fish may be of farmed origin.

The team also found differences in the chemistry of scales between fish farms, which might allow researchers to identify individual farms responsible for the release of wild fish – although this would require additional work.

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