

Captive-bred salmon in wild may do more harm than good

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On average, salmon reared in hatcheries in Ireland's Burrishoole catchment only produced a third as many offspring in the North Atlantic compared to wild fish

Releasing captive-bred Atlantic salmon into the ocean, a long-standing practice to boost stocks for commercial fishing, reduces the rate at

which wild populations reproduce and may ultimately do more harm than good, researchers cautioned Wednesday.

On average, [salmon](#) born in hatcheries in Ireland's Burrishoole catchment only produced a third as many offspring in the North Atlantic compared to [wild fish](#), according to a study in the Royal Society's biological research journal *Proceedings of the Royal Society B*.

"We have also shown that—in years where you have a greater input from captive-bred Atlantic salmon—the ability of the population as a whole to produce more wild-bred fish is reduced in subsequent years," lead author Ronan James O'Sullivan, an evolutionary biologist at University College Cork, told AFP.

It has long been assumed that wild and captive-born fish were "ecologically equivalent," but the new research shows otherwise.

Fish reared for any period of their life in an aquaculture environment, it turns out, somehow change compared to their wild counterparts.

Productivity decline

"You are not replacing like with like," O'Sullivan said by phone.

"What is really worrying is that, with an increased proportion of captive-born spawners, a population's productivity"—the rate at which it reproduces—"declines linearly."

"That means that when you have a healthy, self-sustaining population of salmon, there is no level at which it is safe to stock fish," he added.

The stocking of salmon in the wild has been going on for nearly 150 years in the northern Pacific and Atlantic where several species of the

highly prized fish are endemic.

For decades, scientists have tagged and taken [genetic samples](#) from virtually all salmon passing through the Burrishoole catchment, a low-lying maze of lakes and waterways in western Ireland.

Unlike farmed salmons, which spend their entire lives in aquaculture facilities, the captive-bred fish are released into the wild as juveniles, or smolts.

Genetically hard-wired to swim downstream into the ocean, they spend time feeding and—if they have survived—return to the same catchment to spawn.

They are channeled into a trap and identified.

Wild salmon are allowed to continue their instinct-driven odyssey further upstream to lay eggs, and—on the way back to the ocean—enter a separate trap, where they too are genetically catalogued.

Nowadays, captive-bred fish are prevented from moving upstream to segregate them from wild fish, but previous policies had resulted in the two groups having the opportunity to mate together in the wild.



Salmon at a Norwegian salmon farm

"Because we can track the genetic pedigree of the fish over generations, we can count the number of offspring that a given fish has had," O'Sullivan explained.

Scientists can also tell them apart visually because captive-born fish have a fin clipped and a metal tag in their nose.

With climate change, a 'perfect storm'

There are several possible explanations as to why salmon reared in hatcheries change so quickly—to the apparent detriment of [wild](#)

[populations.](#)

The first is genetic.

"Captive-bred fish are no longer choosing who they mate with—it is hatchery managers that decide," O'Sullivan said.

Moreover, these professional matchmakers are selecting from a small subset of the wild population with a very limited gene pool.

That means the loss of genetic diversity with each breeding event, especially as the fish selected were themselves born in hatcheries.

This could lead, O'Sullivan speculated, to the silencing or mutation of genes useful for surviving in the wild, such as one that signals when salmon should emerge from their winter torpor.

There could also be an ecological effect.

While captive-bred salmon have proven to be less fit in the wild, the absence of predators as they grow up in hatcheries before being released makes them bigger and females produce more eggs.

"The wild-born offspring could simply be outnumbered and displaced by the captive-born ones," O'Sullivan said.

Finally, the explanation for the difference between the wild and hatchery-raised salmon could lie in the realm of epigenetics, which are non-genetic effects that can nonetheless be inherited. This possibility, however, remains purely speculative for now.

Looking ahead, O'Sullivan also worries about the impact of climate change.

Earlier research has already established a link between warming river waters in Northern Spain and southern France and the local extinction of Atlantic salmon in those regions.

"If increasing temperatures make the rivers in Ireland less viable for fish to live in, coupled with the fact that rivers are producing less [fish](#) because of stocking policies, then it would be a perfect storm," O'Sullivan said.

More information: Ronan James O'Sullivan et al. Captive-bred Atlantic salmon released into the wild have fewer offspring than wild-bred fish and decrease population productivity, *Proceedings of the Royal Society B: Biological Sciences* (2020). [DOI: 10.1098/rspb.2020.1671](https://doi.org/10.1098/rspb.2020.1671)

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