Who drugged the salmon?

Researchers did, to study the impact of pollutants in rivers and lakes. **Annie Roth** reports

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In 2022, Jack Brand, an environmental toxicologist, loaded a bunch of Swedish fish with cocaine. He wanted to see how salmon in the wild reacted to pollution from the illegal drug.

In recent years, there has been an alarming rise in the number of waterways polluted with cocaine, prompting scientists to wonder how fish might be handling their highs. In a study published last month in *Current Biology*, Brand and his colleagues show that coked-up salmon swim faster and travel farther than their sober counterparts. This study prompts additional questions about the effects human drug habits may be having on salmon and other freshwater fish.

It wasn't easy for Brand, a researcher with the Swedish University of Agricultural Sciences in Uppsala, to get permission from local governing bodies to dose fish with the drug.

Countless studies have looked at how fish and other animals respond to cocaine in a laboratory setting. But none had studied the impact of the drug in the real world.

As soon as they got permission, Brand and his team headed to an Atlantic salmon hatchery in southern Sweden and began implanting dozens of two-year-old fish with tracking tags and slow-release capsules. Some contained cocaine while others had benzoylecgonine, a compound created when our bodies break down the drug.

The capsules were designed to give the fish the amounts of cocaine or benzoylecgonine each day that would be equivalent to what they would get by living in a polluted waterway.

The fish were then released into Vättern, a lake in Sweden that is routinely stocked with Atlantic salmon for recreational fishing. For eight weeks, the researchers tracked the movements of the young salmon. They were not surprised to see that the hopped-up salmon swam more. What was unexpected was that the salmon receiving doses of benzoylecgonine swam nearly twice as far per week and travelled more than 12 kilometres farther from their release site than the undosed salmon who had been released alongside them.

"Our results suggest that risk assessments focusing only on cocaine may underestimate the ecological effects of its breakdown products," said Tomas Brodin, a co-author of the study.

A 2016 study of the salmon in the Puget Sound in Washington found Prozac, Advil, Benadryl and Lipitor, as well as cocaine, in the tissues of juvenile chinook salmon.

It's unclear if swimming faster and farther while under the influence harms the fish.

"The rule of thumb in our business is that any alterations to physiology or behaviour in fishes should be considered adverse," said James Meador, an environmental toxicologist and affiliate professor at the University of Washington, US.

Meador, who was not involved with the study, stresses that fish are highly tuned to their environments. "Any change in that definitely affects them in some adverse ways," he said, like forcing them to expend more energy.

The presence of drugs and their metabolites in aquatic environments is "an environmental engineering problem", Meador added. In the US, treatment facilities process approximately 34 billion gallons of wastewater every day. Outfitting these facilities with infrastructure designed to remove undesirable chemical compounds from wastewater would be costly and logistically complex. But it's also not a fantasy.

"People are working on it," he said. "I'm optimistic that someday it will reduce a lot of these things."

Brand hopes that day comes soon. He sees cocaine, benzoylecgonine and other human-crafted chemicals as "invisible agents of global change". He warns that "people don't have a good appreciation for the potential effects they can have".

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