Fish

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By late April, more than half the juvenile salmon captured by the U.S. Fish and Wildlife Service in that area tested positive for C. shasta. Genetic analyses found that, during the first week of May, 63% of captured fish contained enough of the parasite's DNA to be considered severely sick — and likely unable to recover from the disease.

At the end of last week, the Yurok Fisheries Department collected 106 fish in a screw trap near Weitchpec, just a few hundred feet upstream from where the Trinity River joins the Klamath in its march to the Pacific. Eighty of them were already dead.

"In a regular trapping season, to see three to five is normal," said Jamie Holt, a fisheries technician for the Yurok Tribe.

On Wednesday morning, Holt and fellow fisheries technician Gilbert Myers launched a boat out to the screw trap to check on that day's catch. The trap looks like a giant rotating cement drum attached to a barge on the southern bank of the river. A corkscrew within the drum funnels fish and other river creatures into a submerged box at the back of the barge, powered by the river's flow.

They set up buckets and tables to sort the fish caught in the trap. By virtue of their size and strength (or lack thereof), almost all of the catch are juveniles — some Chinook salmon, steelhead and wormlike Pacific lamprey. Myers scooped moss and other debris from the trap, dumping them onto a slab for Holt to sort through.

"Oh," Holt said with glee. "We're looking happier."

It was the most positive catch since May 4, when fish mortality began to spike. All in all, 25 fish were dead, compared to 47 the day prior and the low 70s before that. Holt said the "mort bucket," a receptacle for the dead juveniles, had been heavily stacked for the past few days. This was the first day you could see the bottom.

In the spring and early summer, the Yurok Fisheries Department checks the trap every weekday, accumulating data about how C. shasta is impacting salmon in real time. The parasite is a natural occurrence across watersheds in the Pacific Northwest, but few other rivers can compare their outbreaks to the Klamath's.

"C. shasta's always present in the system. It's just never this prevalent," Holt said.

The parasite begins life inside an annelid worm called Manayunkia occidentalis, which anchors itself on rocks and filter-feeds on the riverbed. When the spore matures, the worm releases it into the water column where it infects a host fish. C. shasta then wreaks havoc on the fish's insides, causing it to swim erratically and, when the infection is insurmountable, eventually die. The spore exits the dead fish and re-enters the worm to restart its life cycle.

The Klamath really stands out where the worms are concerned, in what's known as the infectious zone downstream of Iron Gate Dam between the Shasta and Scott Rivers. Just as it blocks salmon from moving above it to the Upper Basin, the dam blocks fine sediment from continuing downstream.

The dam also heavily regulates the flow of water in the infectious zone, creating a relatively calm habitat for the worms. In some areas, they coat large boulders like a shag carpet, forming a gauntlet for young salmon to swim through on their way to the ocean.

Holt said life for salmon during their first year at sea is hard enough, and limiting the number of individuals that even make it to the mouth of the river only makes things worse.

"This is the time of year that these guys should not be stressed at all," she said. "Their hard time is yet to come."

With sediment blocked behind Iron Gate Dam, the only way to scour the worms from the riverbed is through an intense flow event called a flushing flow, which sends as much as 6,000 cubic feet per second of water from the dam over two to three days in the spring.

Research has shown that this flow level is high enough to limit the worm colonies and mitigate a future outbreak. If the dams weren't in place, scientists say the natural flow of sediment combined with storm events in the winter would likely be strong enough to check the worms, and by extension, C. shasta.

"The fix for it in the short term is water," said Mike Belchik, senior water policy analyst for the Yurok Tribe.

Water is exactly what wasn't available this spring, after record-low inflows to Upper Klamath Lake and competing Endangered Species Act requirements for fish habitat there forced the Bureau of Reclamation to cancel a spring flushing flow for salmon on the Klamath River.

The Klamath River at Martins Ferry, on the Yurok Reservation.

Alex Schwartz/Herald & News photos

Jamie Holt lines up the dead fish collected Wednesday morning by the Yurok Tribe's Weitchpec screw trap. With 25 "morts," as they're called, it's the best day fishery staff have seen since the beginning of May. But it's still well above what they'd expect in a typical year — and a typical river system.

Wednesday's trapped dead fish that have succumbed to the disease C. shasta. Though trap mortality has lowered in the past week, spore counts have jumped up again, suggesting that the outbreak is not over.

Coho salmon in the river are already listed as threatened under the ESA, and the Karuk Tribe and Salmon River Restoration Council recently submitted a petition to the National Marine Fisheries Service to list spring Chinook salmon as well. The petition cited C. shasta as a factor threatening species survival.

Beyond receiving baseline flows from Iron Gate Dam as outlined in the NMFS Biological Opinion concerning Coho salmon, the Klamath's major tributaries, like the Scott, Shasta, Salmon and Trinity Rivers, are also flowing significantly below normal. The Klamath River at Orleans, which at this time of year would flow at a median of nearly 10,000 cubic feet per second, is seeing less than 40% of that normal level.

Given how warm and dry this spring was, researchers say a cancelled flushing flow meant a recipe for disaster on the entire lower river beyond just the infectious zone. Fishery biologists from the Karuk Tribe further upstream have reported similarly high mortality in traps near Kinsman Creek, and at one point in mid-April, all six monitoring sites reported spore concentrations above 10 spores per liter.

"This kill is basin-wide," Holt said. "Typically, when there's been die-offs in the past, it's been extremely area-specific."

For Sascha Hallett, associate professor in the department of microbiology at Oregon State University and an expert on C. shasta, the river's conditions meant that a fish kill of this severity wasn't surprising. High spring temperatures and considerably low precipitation provided an ideal environment for a waterborne outbreak.

"It was a warm, dry spring," she said. "That's immediately of concern."

Hallett said temperature and flow, the main drivers of an outbreak, have a complex relationship. Too low of a temperature and C. shasta spores won't even activate (thus their disappearance during the winter); too high of a temperature, and they'll disintegrate.

But salmon also have their own temperature threshold: Too cold, and they won't migrate; too warm, and they'll make too many pitstops in cold-water creeks, putting them more at risk of catching and succumbing the disease as they spend more time in the river, stressed out by its high temperature.

Low flows make juvenile salmon move more sluggishly, while high flows can flush the worms and swiftly carry the fish out to sea. If flows are high but not high enough, the river allow juveniles to come into contact with more spores. When flows are too high, fish stay sheltered in creeks, too timid to enter the rushing mainstem. Higher flows also tend to reduce water temperatures.

"There's a certain sweet spot of diluting the spores, encouraging the fish to outmigrate and decreasing the temperatures," Hallett said. With so little water available for management decisions this year, the disease played out with no large-scale mitigation efforts to achieve that magic flow number.

Like any disease, C. shasta has a variety of epidemiological markers that provide warning signs for what could come next. First is the spore density: Hallett said when that number rises, you can expect to see the effects on fish within a couple weeks. That will first show up in the disease severity data, in the percentage of captured fish that are exhibiting mortality-level loads of the parasite. Then, traps will start to catch more and more dead fish.

"A high prevalence of infection is not particularly concerning," Hallett said. "What is concerning is the severity of infection and the population-level impact."

Hallett said another rarity is seeing dead fish floating in the river outside the traps, like the Yurok Fisheries Department have. Juvenile fish kills are hard to notice if you're not looking for them, as the small fish usually sink into deep pools or get eaten by predators when they die.

"if we are actually observing dead and dying juveniles, that is a concern," Hallett said. "Normally, dead wild fish disappear readily from the system."

Seeing dead juvenile salmon floating in the river usually means there's too many to disappear.

A large group of Klamath Basin scientists, researchers and water managers convene every Friday morning to discuss hydrologic conditions in the watershed. The Flow Account Scheduling Technical Advisory (FASTA) meetings bring together multiple datasets, from spore concentrations to flow levels to anecdotal observations of river conditions. Hallett said she's heard worried testimony from participants over the past few weeks.

"The words that have been used for this year are really quite astonishing," she said. "If you use the word 'unprecedented' for the Klamath River, that's saying something."

Closing up the trap Wednesday morning, Holt was hopeful that things would continue to improve. But Friday's FASTA meeting presented less-promising data. Though spore concentrations had reduced last week — likely due to cooler, wetter weather and a release of colder water from the depths of Iron Gate reservoir — they rebounded this week at nearly all sites.

The number of fish with severe C. shasta also reduced to 15%, but Hallett said that with more healthy juveniles potentially entering the spore-rich river from its tributaries, she expects that number, along with mortality, to increase again. Also concerning are increased spore concentrations of a second genotype of C. shasta that specifically affects Coho salmon.

Even on the Yurok Reservation, where spore concentrations would usually be low so close to the river's mouth, the Tully Creek site reported 13 spores per liter right below the confluence with the Trinity River.

"Fish coming in from the Trinity are entering their own hotspot right now," Hallett said. "It doesn't have an ending yet."

As a Yurok tribal member herself, Holt looks at the dead fish she collects every week and sees more than just a row of limp, milky colored salmon. She sees the decline in a life force the Yurok have depended on since time immemorial.

It's a cultural impact at its core, but there are economic ramifications too: Due to low returns resulting from previous disease outbreaks, the Yurok Tribe cancelled its commercial fishing season for the fifth time this year, and subsistence fishing is still highly regulated.

"Eighty fish could potentially feed 10 to 12 families," Holt said. "Those aren't just tribal families — there's ocean fishermen and sport fishermen. We all live downstream."

And since salmon spend between two and five years in the ocean before making their way back upstream to spawn where they hatched, Holt said this fish kill will have far reaching effects. According to data from the U.S. Fish and Wildlife Service, the number of salmon caught at a trap just downstream of Iron Gate Dam peaked around the same time as C. shasta spores, suggesting that the majority of this year's outmigrating juveniles haven't been able to escape the outbreak.

"We're going to feel these losses two years from now when there's no returners," Holt said.

Hallett pointed out that this year-class of salmon is also expected to make up the majority of returners in 2023, when the four dams on the mid-Klamath River are slated to be removed, opening up hundreds of miles of new salmon habitat.

"It's grim. Anybody who cares about the river or works on the river are concerned about the fate of these fish," she said. "If dam removal goes ahead as scheduled, these are the fish we've got a hope on for repopulating the Upper Basin. We're not off to a good start."

For Myers, it's especially frustrating to think about how sophisticated disease monitoring efforts have become, only for the management decisions they recommend to be ignored. In addition to calling for immediate relief to all communities in the basin impacted by this year's severe drought, he said the watershed needs to transform the way it operates.

"We've spent decades building our scientific infrastructure. We've spent decades developing our biologists, our teams and our program to be able to predict and prevent fish kills from happening," Myers said. "We predicted this to happen. The data laid it out, we presented it. I don't know what more we're supposed to do."