Scientists find ongoing peril to fish in Klamath

Salmon die-off | Parasites unique to the Northwest that particularly affect young fish are taking a heavy toll

By BEN LARSON
THE OREGONIAN

Five summers ago, Klamath River flows dropped to historically low levels just as chinook salmon began their autumn run upriver to spawn. Despite scientists' warnings, the U.S. Department of Interior ordered the diversion of river water.

At least 34,000 adult salmon died, infected by bacteria and parasites that multiplied rapidly in the unusually high water temperatures and low river levels.

"When you get a lot of fish together in warm water temperatures, the pathogens just go back and forth between them and really proliferate," said Jerri Bartholomew, an Oregon State University microbiologist .

Congressional hearings scheduled for Tuesday will attempt to unravel the decision-making that led to the 2002 salmon die-off. But scientists say the peril to Klamath salmon populations existed even before that catastrophe, especially for young salmon.

"The loss of juveniles has probably been going on for quite a number of years, and not a lot of attention was being paid to it until that 2002 fish kill," said Bartholomew, who is studying the prevalence of parasite infection in Klamath fish.

Juvenile salmon — called smolts — hatch in the headwaters of the Klamath, then migrate to the open ocean to feed for around four years, bulking up. The adults then make the tortuous swim back upriver to spawn before dying.

Adult salmon, mostly chinook, that died in the 2002 fish kill failed to reach their spawning grounds. Far fewer eggs hatched, and Klamath salmon

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populations plummeted over the next few years.

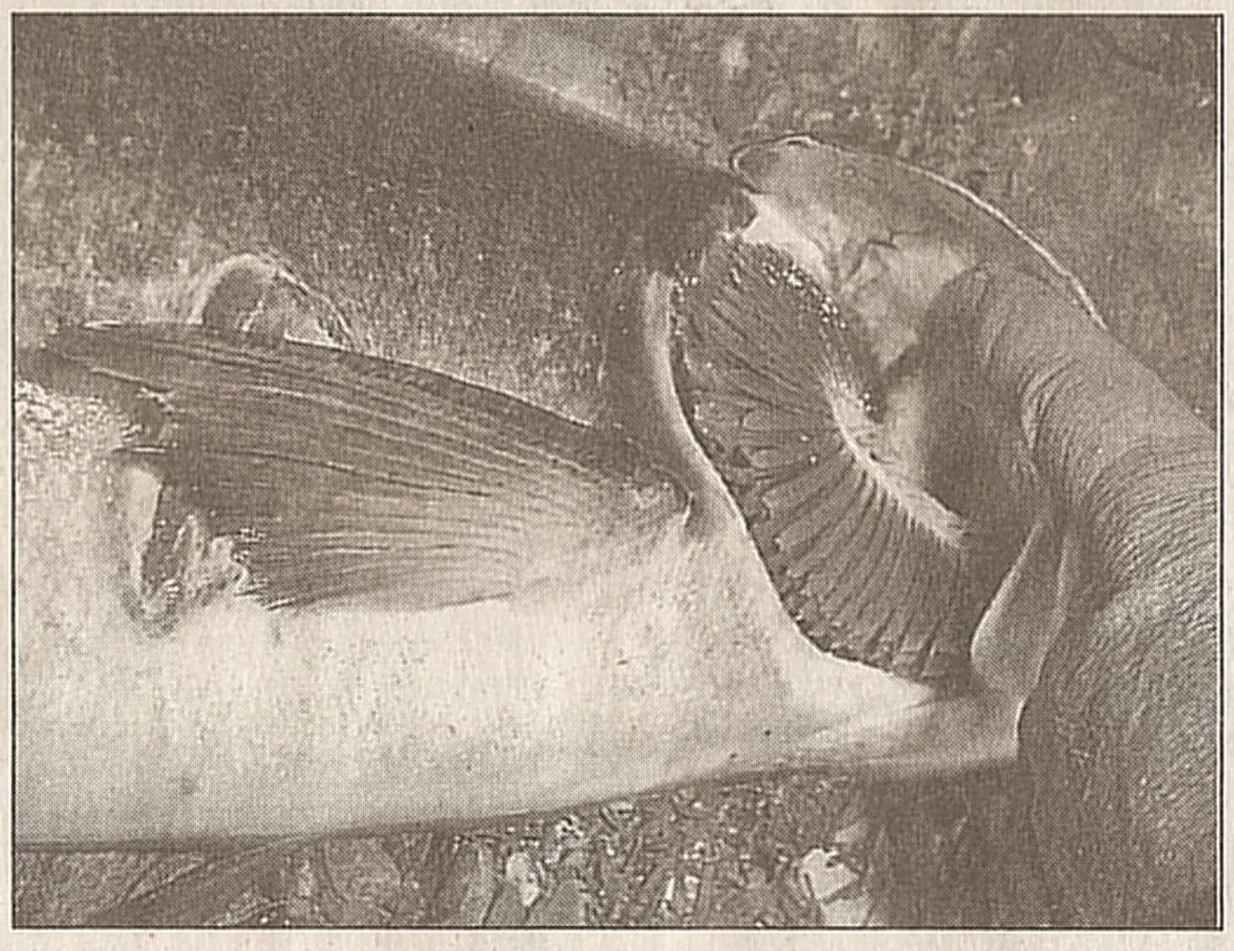
But even when adults successfully complete the trek to their spawning ground, their offspring die in large numbers every year.

"When you're losing 40 to 50 percent of your outmigrants, that's a huge number of fish, and you're not going to be able to recover those populations," Bartholomew said.

For juveniles, the biggest culprits are parasites unique to the Northwest: *Ceratomyxa shasta* and *Parvicapsula minibicornis*.

The parasites are a normal part of the ecosystem, and fish native to the area are usually resistant to them. But a combination of factors, including the introduction of nonnative and hatchery fish without this resistance and changes to river flow caused by dams, has upset the natural balance between fish and parasite.

The microbes split their time between salmon and marine worms called polychaetes. Parasites in the worm release buoyant spores — called actinospores — that float up into the water where they can infect passing fish. Once embedded in the fish host, the parasite begins cranking out compact spores — myxospores — that sink to the river muck. There, the parasite sets up shop in another worm and begins the cycle again.



TOZ SOTO

A Karuk tribal biologist checks the gills of a chinook salmon for an infection by columnaris bacteria, commonly called gill rot. The gills of the fish show no sign of infection, but the gash farther back shows the bacteria has eaten away about half the fin.

The reason for the dual-host life cycle is not entirely clear, said Bartholomew, but "it probably helps them get around."

And get around they do.

In some cases, parasites infect as much as 90 percent of outmigrating salmon smolts, said Scott Foott, a biologist with the California-Nevada Fish Health Center, a division of the U.S. Fish and Wildlife Service.

While conducting salmon surveys in the Trinity and Klamath rivers in the early 1990s, Foott and other biologists discovered a problem.

"We saw a very high incidence of diseased fish due to *Ceratomyxa*, and we started asking specific questions," said Foott, whose study was published last month in the Journal of Aquatic Animal Health. His research found that infectious spores released by parasites in the worm can last in the river for up to seven days.

Microscopic assassins occasionally reveal themselves in dramatic fashion, as they did in the 2002 adult fish kill. In that instance, bacteria known as columnaris and parasites called *Ichthyophthirius multifiliis*, or "ich," devastated the salmon population in the Klamath.

"They probably had *Ceratomxya* too, but those other two pathogens replicate more quickly and kill the fish off first, so it's just like a big arms race to see who's gonna do them in before they can spawn," Bartholomew said.

Long-term monitoring shows that more fish are affected by slow-acting parasites than the rapidly spreading ones responsible for the 2002 incident, Foott said. Every year, parasites quietly kill huge numbers of tiny smolts, but dead juvenile fish don't show up as prominently as the corpses of adult fish.

The fast metabolism of young fish makes them more vulnerable to fatal parasitic infection.

"When the adults are returning in the fall, they can take a fair amount of damage because they're no longer feeding and they shunt blood away from the intestine," Foott said. "Infection of a juvenile fish causes the intestine to bleed profusely. They basically bleed out."

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