Warming seas could wipe out Snake River chinook by 2060, scientists predict

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Snake River spring-summer chinook could be nearly extinct by 2060 and interventions are "desperately needed" to boost survival in every stage of their lives, scientists warn.

The findings, published Thursday in the journal *Communications Biology*, modeled survival of eight populations of wild Snake River Basin spring-summer chinook during the ocean phase of their life, under various climate-warming scenarios.

Salmon hatch in rivers, but mature for years at sea before they return to the waters of their birth. It is a perilous life cycle that could become all but impossible for some already fragile salmon populations that make one of the most arduous of all journeys, all the way to Idaho. They travel more than 1,800 miles round trip, climb more than a mile in elevation, and tackle eight dams, each way: four on the main stem Columbia, then four more on the Lower Snake River.

Add just a little ocean warming, and it's curtains. Populations declined in all eight basin chinook populations for which the scientists ran predictions. Just a little more than 1 degree Celsius temperature increase in sea-surface temperature produced dire effects—with mortality as high as 90% in warmer seas.

The findings spotlight a need for immediate action, said Richard Zabel, an author on the paper and head of the fish ecology division at the National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center in Seattle.

"Dam breaching and all alternatives have to be on the table," Zabel said.

It was these very same salmon populations that Republican U.S. Rep. Mike Simpson, of Idaho, recently called out for rescue in a more-than-$30 billion plan he has proposed as part of a national infrastructure package expected to be introduced in Congress later this year.

Simpson envisions a Northwest portion of a multitrillion-dollar bill to reshape energy, transportation and hydropower in the Northwest. He also

calls for breaching all four Lower Snake River dams to rescue Snake River salmon.

The scientists did not model whether dam removal on the Lower Snake would help the fish. But far from turning away from restoration efforts, the scientists concluded interventions in both the marine- and fresh-water environments are "desperately needed."

"We have shown that prospects for saving this iconic keystone species in the conterminous U.S. are diminishing," the scientists wrote. "… The urgency is greater than ever to identify successful solutions at a large scale and implement known methods for improving survival."

The ocean can't be forgotten in the flurry of attention to dam removal, cautioned Brian Burke, an author on the paper, and a supervisory research fisheries biologist. While the Simpson proposal is exciting in its comprehensive nature, Burke said the ocean has to be part of the picture.

"Even if survival in the river was 100%, they are not going to recover if we don't do something about the ocean," Burke said of Snake River Basin salmon.

And there is plenty in the ocean to do, Burke said. First, more and better monitoring is needed to understand what happens to salmon once they reach the sea. Research is needed to study the prey these salmon depend on. Not enough is known about the behavior of predators that eat these salmon either.

The message of the paper is not "give up, they are doomed," but rather, the opposite, Burke said. "We have to get serious.

"How much might dam removal impact survival, versus this, versus that—we need to at least evaluate these things," Burke said. "There is a

lot of scientific argument in the region, and I don't know that we can just continue in argument."

While the scientists focused on wild Snake River Basin chinook, the species across all of its southern distributions in the region could be just as direly affected by warming sea-surface temperatures, the scientists warned, in a "widespread" phenomenon.

Of course, it could all come out differently, the scientists said, stating at least two main caveats to their findings: The northeastern Pacific may not warm as they have predicted. And even if warming occurs, there could be an ecological "surprise" that upends the expected harm by sea-surface warming to salmon, a cold-water animal.

Warm conditions in the sea have long been associated with lower-quality salmon prey, and more warm-water predators. But perhaps the salmon, or their prey, or their predators, will adapt in ways not predicted, the scientists said.

As for dams, survival for salmon migrating through the Columbia and Snake is about 50% today, about the same as in rivers of similar length without dams, such as the Fraser, the scientists stated.

However, slow travel time through slow-moving reservoirs behind dams, combined with increased surface temperatures in the reservoirs, could potentially result in lower marine survival, the scientists found.

Reservoirs also have created great conditions for salmon predators.

Dam removal on the Lower Snake has been found by several science panels and reviews to offer the best chance for the long-term survival of Snake River salmon—and species that depend on them, such as southern resident killer whales.

Dam removal on the Lower Snake has been the subject of federal court battles for decades. A recent federal environmental study that found no harm to salmon survival from Columbia and Snake dam operations has once again been challenged in court.

Lisa Crozier, lead author on the paper, and a research ecologist at the Northwest Fisheries Science Center, said improvements in habitat to boost salmon survival also benefit other species—including humans.

Improvements to shoreline, estuary and flood-plain areas will help salmon, but also buffer storm surge, flooding and other effects of climate change.

"We can use natural solutions—it is so much cheaper than our engineering responses, in the long run," Crozier said. "And restoration benefits so many more organisms who will then do the temperature moderation for us."

More information: Crozier, L.G., Burke, B.J., Chasco, B.E. et al. Climate change threatens Chinook salmon throughout their life cycle. Commun Biol 4, 222 (2021). doi.org/10.1038/s42003-021-01734-w

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