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Fisheries

# Study: Hatchery and fisheries management changes could help stabilize California's Chinook salmon

28 February 2023

**By Responsible Seafood Advocate**

## Returning to spawn in the Sacramento River at different ages could help stabilize the chinook salmon population

Changes in hatchery practices and fishery management could help restore the age structure of the salmon population and make it more resilient to climate change, according to a new study from scientists at UC Santa Cruz and NOAA Fisheries.

Spawning Chinook salmon are increasingly younger and concentrated within fewer age groups, with the oldest age classes of spawners rarely seen in recent years. The study, which was published in the ***Canadian Journal of Fisheries and Aquatic Sciences*** **(https://cdnsciencepub.com/doi/full/10.1139/cjfas-2022-0171),** indicates that by returning to spawn in the Sacramento River at different ages, Chinook salmon reduce the potential impact of a bad year and increase the stability of their population in the face of climate variability.

If most of the salmon return to spawn at the same age, one bad year could devastate the overall population. Spreading the risk over multiple years is an example of what ecologists call the "portfolio effect," like a financial portfolio that spreads risk over multiple investments.

Scientists measure an adult salmon during a tagging project off the coast near Bolinas. Chinook salmon return to spawn in the Sacramento River at different ages, but spawning salmon are increasingly younger and concentrated within fewer age groups, with the oldest age classes rarely seen in recent years. Photo by Jeremy Notch.

"We focused on the impacts of drought on the survival of juvenile salmon, but drought conditions can also increase mortality of returning adult salmon as they migrate upstream to spawn," said Paul Carvalho, co-author and a postdoctoral fellow with the Fisheries Collaborative Program at UC Santa Cruz

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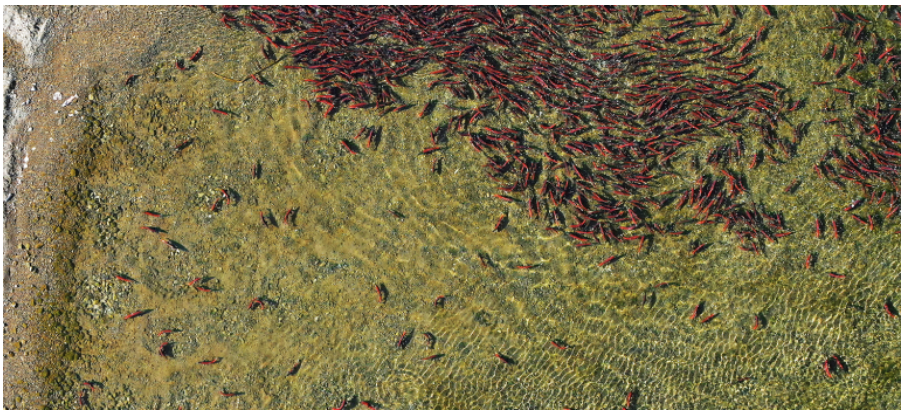
Carvalho developed a life cycle model of the Sacramento River fall-run Chinook salmon population to simulate the effects of different drought scenarios and other variables on the population. The model was grounded in data from field studies, such as research by NOAA Fisheries scientists that quantified

the relationship between river flows and survival rates of juvenile salmon. The model allowed the researchers to assess the effects of different mechanisms that can affect the age structure of the population.

“Historically, you would have seen huge salmon coming back at older ages, but over the past century they’ve gotten smaller and younger,” said Eric Palkovacs, co-author and director of the Fisheries Collaborative Program. “The dominant age class is now three years, and there are very few even at age five, so there’s been a big shift in the age structure.”



## As Yukon Chinook salmon populations decline, researchers turn to technology for answers

Using drones, researchers seek to better understand where, along an almost 2,000-mile migratory route, things go wrong for Chinook salmon.

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Decreased size and age at maturity is a classic pattern of fisheries-induced evolution. A high mortality rate for older fish selects for fish that mature at earlier ages, because a fish that dies before it can spawn doesn’t pass on its genes. But fishing pressure is not the only factor driving changes in the age structure of the salmon population. Hatchery practices can also inadvertently select for earlier maturation.

“It’s pretty clear that current hatchery practices are resulting in very homogeneous populations returning at age three,” Palkovacs said. “Rather than producing a uniform product, it would be better to increase the diversity of the age structure by selecting older, larger fish and making sure you get as many of them into the spawning population as possible.”

Carvalho noted that improving the age structure of the population by selecting for fish that spend more years at sea (delayed maturation) would be most effective in combination with reduced harvest rates.

"Because the fish remain in the ocean longer, they are exposed to the fishery and other causes of mortality for a longer period, so that reduces the number returning to spawn if you don't reduce fishing pressure on those older age classes," he said.

Overall, the results show that maintaining or increasing the age structure through reduced mortality and delayed maturation improves the stability of the salmon population, buffering against the adverse effects of drought and making the population more resilient in an increasingly variable climate.

"Regardless of the mechanism, whether it's reduced mortality or delayed maturation that's driving it, increasing the diversity of the age structure will increase the stability of the population," Carvalho said.

**Read the full article here (https://cdnsciencepub.com/doi/10.1139/cjfas-2022-0171).**

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