



EXECUTIVE SUMMARY

Left Out in Drought: California Fish

Impacts of the California Drought on Freshwater Ecosystems

Morgan Shimabuku and Cora Kammeyer



September 2022

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ABOUT THE AUTHORS

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Morgan Shimabuku is a Senior Researcher at the Pacific Institute. She conducts research on a wide range of water management issues, including solutions to water equity and access challenges, benefits and trade-offs of water management strategies, and a universal approach for measuring water resilience at the basin scale. Prior to joining the Pacific Institute, Morgan was a senior program manager at an environmental nonprofit in Colorado where she ran residential and commercial water conservation program operations in partnership with municipal water providers. Previously, she worked as a scientist at a water resource consulting firm and supported the PacFish/InFish Biological Opinion Effectiveness Monitoring Program of the US Forest Service as a stream technician. Morgan received a bachelor's degree in Environmental Studies and Geology from Whitman College and a master's degree from the Department of Geography at the University of Colorado, Boulder, where she studied climate change, hydrochemical cycling, and snow hydrology at the Institute of Arctic and Alpine Research.

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Cora Kammeyer is a Senior Researcher at the Pacific Institute, where she works on Western US water policy, urban water efficiency and reuse, corporate water stewardship, global water governance, and more. Much of her work supports the California Water Action Collaborative and the UN Global Compact CEO Water Mandate. Her interests are centered on creative solutions that balance the social, environmental, and economic dimensions of water. Cora's past work has focused on environmental water markets, Western US water law, LEED green building certification, and behavioral science techniques to encourage residential water conservation. Cora holds a bachelor's degree in Environmental Studies with a minor in Spanish from the University of California, Santa Barbara. She also holds a master's degree in Environmental Science and Management from the Bren School at UCSB, where she was a Sustainable Water Markets Fellow.

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California is deep into the third year of another major drought. Rural and urban areas again face water use restrictions and financial losses. Less water and hotter temperatures also stress ecosystems, increasing the prevalence of wildfires, air pollution, dry streambeds, and loss of wildlife. Impacts to rural and urban areas frequently mask the disproportionate ecological impacts of the drought and the related policy and management responses that have exacerbated those impacts. The lack of acknowledgement and deprioritization of ecosystem water needs during drought has led to insufficient actions taken to protect the natural systems on which we all depend.

This report highlights the significant and persistent threats of the current drought—and the associated policy and management responses—to fish and to freshwater ecosystems more broadly. Our goal is to expedite improved management responses by informing communities and policymakers of the severity of the drought’s impact on aquatic ecosystems, and by recommending strategies and solutions that build drought-resilient water systems now and for generations to come.

In this report, we focus on drought impacts on fish in the Sacramento River, San Joaquin River, and San Francisco Bay-Delta (Figure ES1) during the current drought. This report builds on the extensive expertise and experience of many who have documented these impacts for decades.



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Figure ES1. Sacramento River, San Joaquin River, and San Francisco Bay-Delta with Select Cities and Dams ↗



Data sources: State of California n.d.; USGS n.d.; Zarate 2012

THE DROUGHT’S IMPACTS ON FISH IN CALIFORNIA

Freshwater species in California are adapted to periodic droughts and floods, but human alterations to freshwater ecosystems combined with de-prioritization of these ecosystems during droughts reduce species’ ability to withstand them. During droughts in California, freshwater ecosystems experience low water flows generally, but also lower and shorter peak flows, warmer temperatures, and reduced water quality. For multiple days and even months in 2020 and in 2021, temperatures in the Sacramento and San Joaquin rivers exceeded the lethal limit for salmon. The diminished freshwater flows in 2020 and 2021 also resulted in exceedances of salinity thresholds at multiple monitoring locations in the San Francisco Bay-Delta. Due to stagnant water, high temperatures, and high nutrient loadings, harmful algal blooms in the Delta were nearly twice as extensive in 2021 as they were in 2020, reducing oxygen levels and threatening fish, animals, and people.

Low water flow, warmer temperatures, and poor water quality in many freshwater ecosystems across the state have resulted in deadly conditions for fish in the past two years. One of the best-known examples of impacts to fish species was on the endangered winter-run Chinook from the Sacramento River. In 2021, when river flows reached an 11-year low of 6,400,000 acre-feet, the egg-to-fry survival for winter-run Chinook reached a historic low of 2.6%, largely due to high stream temperatures.

The drought also affects the communities, economies, and ecosystems that depend on fish. As the numbers of salmon and other ocean and freshwater species decline, commercial and recreational fisheries' earnings decline. For commercial salmon fishing, a decline in fish harvest over time ripples through supporting industries, multiplying the impacts. The drought also adversely affects Native communities, exacerbating existing scarcity of their food, economic opportunities, and material bases for their cultural and spiritual practices.

CONCLUSION AND RECOMMENDATIONS

We offer six recommendations to ensure California fish build resilience to droughts: three for decisions made during droughts and three for ongoing ecosystem management.

1. **Make water management institutions nimbler during drought.**
Remove roadblocks, reduce redundancy, and expedite decisions to protect ecosystems during drought.
2. **Create drought plans for freshwater ecosystems.**
Drought plans and advanced negotiations should allow water and wildlife managers to act proactively and at scale.
3. **Emergency drought declarations should not forgo minimum flow requirements for the environment.**

A variety of approaches should be explored to ensure regulatory requirements for fish and other species are met, especially during drought.

4. **Prioritize freshwater ecosystem protection.**
Wildlife managers should work with local, state, and federal water management agencies to ensure the existing protections of water flows critical to fish survival are being maintained and enforced by regulators, and expanded where they do not exist.
5. **Expedite projects to restore connectivity with and health of floodplains.**
Direct physical connection of floodplains and other habitats adjacent to streams must be maintained and expanded to sustain fish populations.
6. **Standardize and coordinate research and data collection, and improve information on lesser-known species.**
State and federal data are not well coordinated or integrated, limiting the data's utility for making timely and effective management decisions for much of the state.

Droughts of increasing frequency and intensity threaten water needs for California's communities, economies, and ecosystems, and new approaches are needed. California's fish populations are in long-term decline, with several species and taxa facing extinction. Drought exacerbates that decline, as ecosystem water needs go unmet due to policy and management decisions that deprioritize freshwater ecosystem health. As this report shows, the current drought is no exception. However, policymakers and water managers can make changes to improve freshwater ecosystem management—such as those recommended above—and help ensure better outcomes for California's streams, fish, and all who rely on and benefit from them.

For the full report, “Left out in the Drought: California Fish, Impacts of the California Drought on Freshwater Ecosystems,” please visit:
<https://pacinst.org/publication/left-out-in-drought-california-fish-2022/>



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