

CALIFORNIA SALMON STRATEGY FOR A HOTTER, DRIER FUTURE:

Restoring Aquatic Ecosystems in the
Age of Climate Change



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ABBREVIATIONS

California Department of Food and Agriculture	CDFA
California Department of Fish and Wildlife	CDFW
California Department of Transportation	Caltrans
California Department of Water Resources	DWR
California Natural Resources Agency	CNRA
Central Valley Flood Protection Board	Flood Board
Federal Energy Regulatory Commission	FERC
National Oceanic and Atmospheric Administration	NOAA
National Marine Fisheries Service	NMFS
State Water Resources Control Board.....	SWRCB or State Water Board or Water Boards
U.S. Army Corps of Engineers.....	USACE
U.S. Fish and Wildlife Service.....	USFWS
Wildlife Conservation Board.....	WCB



California Salmon Strategy for a Hotter, Drier Future: *Restoring Aquatic Ecosystems in the Age of Climate Change*

Salmon persist across much of California. Every year they swim through California's rivers into the Pacific Ocean and then return several years later to start a new generation. Salmon are central to religions, creation stories, the health and subsistence of Indigenous Peoples, and a multi-million-dollar fishing industry. Salmon nourish soils and forests through their unique journeys that bring ocean nutrients to headwater streams and rivers. Many hardworking people make a living catching and selling salmon, while others simply enjoy catching them for delicious meals. California needs thriving salmon runs.

Four major species of salmon still exist in California – Chinook, coho, pink, and chum. Chinook and coho are the predominate species in the state. The Chinook have different “run types,” which means the time of year those returning fish swim back up



rivers from the Pacific Ocean. For example, spring-run and winter-run Chinook are different. Climate change effects are everywhere including on Chinook run types, and some populations are now migrating earlier than usual and others later.

Steelhead also exist in California, including along the coastline as far south as Los Angeles and Orange counties. Steelhead behave like salmon. Unlike salmon, steelhead can migrate back and forth between the ocean and freshwater rivers to spawn multiple times.

Historically, salmon populations returning to California rivers were estimated to be in the millions, annually. Current populations are a fraction of that and depend heavily upon hatcheries. Many state, federal, and conservation management documents detail the multitude of reasons for this decline over

decades. Each reason traces to how people use and manage land and water and built infrastructure, now with an overlay of extreme climate disruption, which traces to humans, too.

For millions of years, salmon endured global-scale climate variabilities, yet they persisted through their unique and diverse life history strategies. Recovery is built into salmon DNA. This innate resiliency of the species fuels the state's engagement with local communities, Tribal Nations, commercial and recreational anglers, industries, environmental and conservation organizations, federal agencies, landowners, farmers, and ranchers.

This document outlines a path to a healthier, thriving salmon population in California, but achieving this result will have broader benefits beyond salmon. Pacific salmon are truly a keystone species. Scientists

consider keystone species to be those that have a disproportionately large effect on the broader natural environment relative to the specific species abundance. Salmon are one of nature's "force multipliers" super-charging benefits across entire ecological communities. Their health influences the whole ecosystem. They are food for other species. Their bodies enrich habitats through cycling of nutrients from ocean to rivers. Restoring habitat for salmon benefits many additional aquatic species. Creating passage for salmon past barriers helps lamprey and sturgeon and a suite of other aquatic species too. In this sense, a "California Salmon Strategy for a Hotter, Drier Future" is very much a strategy for restoring entire aquatic ecosystems in the age of climate change.

Centering restoration around salmon makes sense. A salmon stronghold may be a watershed, or multiple watersheds in a region where the protection and restoration of that stronghold help create climate refugia for the long term. A network of highly resilient, ecologically important watersheds and habitats creates spill-over effects across a broader landscape, improving its capacity to sustain salmon and other aquatic species. Protection and restoration of this network drives partnerships, prioritization, funding investments, on-the-ground project implementation, and monitoring.

Examples of strongholds include the Smith River; the Klamath River and its tributaries including the Salmon, Scott, and Shasta rivers; certain North Coast coastal watersheds like the Mattole River and South Fork Eel River; the McCloud River headwaters; and, in the Sacramento River region, tributaries such as Mill, Deer, Antelope, Battle, and Butte creeks. While illustrative as examples, these strongholds can be better connected with equal focus on management, protection, and restoration of the larger rivers across the state as well.

After 10 years of rapidly intensifying drought with episodic bouts of rain and snow events, salmon are not doing well. A recent study published in *Fish & Fisheries* analyzes downward abundance trends for more than 80 Chinook salmon populations extending from California's Sacramento River north to the Fraser River in Canada. A co-author of the study said, "[a]s environmental conditions get tougher, it's increasingly important that we understand and maintain the different survival strategies that Chinook salmon have honed over millions of years." Supporting that natural resiliency is the cornerstone of this strategy.



Our goals are to recover salmon in this state across their range, which is aspirational and forward-looking, while also reducing the risk of extinction, which is a short-term and long-term focus. Making these goals a reality will require abundant, healthy populations of salmon that return to California's rivers each year. Healthy year-after-year salmon runs provide more than an opportunity for subsistence, recreational, and commercial fishing – all of which are vitally important to California's people and economy on their own. Healthy returns also protect entire cultures and ways of life, some extending back into time immemorial, and will ensure that all future Californians have the opportunity to experience the state's diverse biology.

Just as California needs salmon, salmon need us. This "California Salmon Strategy" outlines actions state agencies are already taking to stabilize and recover salmon populations and additional or intensified actions needed in coming years. These actions are organized into six priorities.

- 1. Remove Barriers and Modernize Infrastructure for Salmon Migration**
- 2. Restore and Expand Habitat for Salmon Spawning and Rearing**
- 3. Protect Water Flows and Water Quality in Key Rivers at the Right Times to Support Salmon**
- 4. Modernize Salmon Hatcheries**
- 5. Transform Technology and Management Systems for Climate Adaptability**
- 6. Strengthen Partnerships**

This work will require close collaboration with multiple state agencies, Tribal Nations, external partners, and federal agencies – in particular, the U.S. Fish and Wildlife Service, NOAA Fisheries, and the U.S. Bureau of Reclamation. There are many limiting factors and threats for salmon in the state. To prioritize right now, given the urgency, these are six key objectives. We have to get going. Now. The remainder of this strategy explains these priorities and identifies actions that will be taken in the next three years to execute each priority.

It will require time, effort, and funding to carry out this plan. The pace of implementation will depend upon the feasibility and availability of resources and competing priorities.



1. Remove Barriers and Modernize Infrastructure for Salmon Migration

Lead Agency:
CDFW

Primary Partners:
Tribal Nations, Water Boards, DWR,
Caltrans, Wildlife Conservation
Board¹

The infrastructure built generations ago in California continues to limit salmon migration, and some dams that remain on the landscape are well beyond their useful life. In the Central Valley, large dams were built starting in the early 1900s on almost all major rivers. Those dams now block salmon access to over 90 percent of their historical spawning and rearing habitat higher in mountain streams. The remaining cold water salmon need exists at that higher-elevation habitat, while the valley floor habitat will only get hotter with climate disruption. Some dams and infrastructure that are still operational and provide benefits to people can be modernized



Image credit Shane Anderson Swiftwater Films.

KLAMATH RIVER DAM PROJECT

The largest dam removal in American history is underway. Just this fall Copco 2 dam was removed; the remaining three dams will be removed in 2024. This bold step is restorative for so many reasons – to heal the ecosystem of a once prodigious salmon river, to open up hundreds of miles of spawning habitat, and to recognize after so many years of injustice a restored way of life and traditions for Native American Tribes along the river.

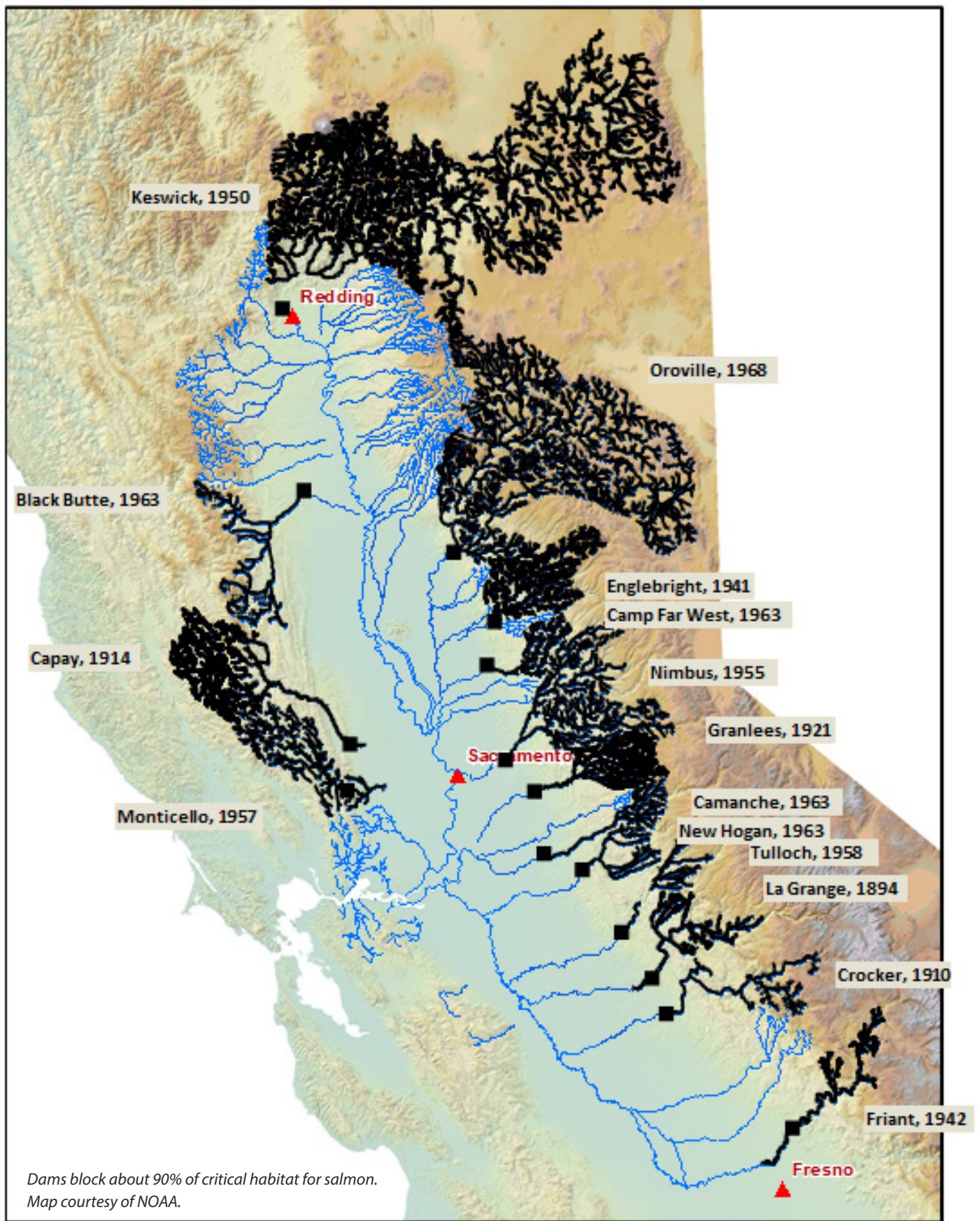
to minimize harm to salmon. Some dam owners are moving to decommission and tear down their defunct structures and need state assistance.

Funding, personnel, and partnerships can be focused, directed, and expedited to remove barriers and modernize infrastructure for salmon migration. Doing so will expand habitat, thereby generating immediate long-term resiliency benefits.

The largest river restoration project in American history is underway to remove four dams on the Klamath River, which once hosted many of the most prodigious salmon runs in California. Dam removal will improve river health for salmon by improving water quality and restoring access to over 420 miles of habitat for the first time in a century. Other dam removal projects with broad support are also underway, including Matilija Dam in Ventura County and Rindge Dam on Malibu Creek in Los Angeles County. Additionally, dam and diversion structure removal actions associated with federally-licensed hydroelectric facilities are underway on Battle Creek and Old Cow Creek/South Cow Creek.



¹ Success in saving salmon requires an “all of the above,” “all-hands-on deck” effort. The list of partners is long. Each of the six priorities focuses on identifying lead state agencies and primary partners. However, all the actions require leadership and partnerships with Tribal Nations, federal agencies like USFWS, NMFS, FERC, and USACE, California’s counties, local government, businesses, water users, conservation and environmental organizations, landowners, and citizens. For Action 4 (hatcheries) federal agencies are included in the header given the owner and operator and regulator relationships amongst and between agencies.



On other rivers where dams remain operational, California can return fish to upstream, cold-water habitat through a variety of measures including natural passageways around barriers, physical passageways, or even by physical transport of fish. On the McCloud River, in the summer of 2022, California made great strides to return Sacramento River endangered winter-run Chinook eggs upstream of Shasta Reservoir for the first time since Shasta Dam was constructed in the 1940s. And, in May 2022, the state moved threatened spring-run Chinook to Clear Creek and returned adult Sacramento River winter-run Chinook to the North Fork of Battle Creek for the first time in more than 110 years. These actions are focused on restoring salmon populations by expanding and improving aquatic habitat.

While important work to reconnect salmon to historic habitat is underway, additional actions in key watersheds are needed.



Working together, state agencies and partners will do the following, depending upon available resources:

- 1.1** By the end of 2023, remove the first of four dams on the Klamath River, and complete the removal of the remaining three in 2024. (CDFW, DWR, CNRA)
- 1.2** By the end of 2023, reach an initial agreement with Tribal Nations, counties, and conservation organizations to decommission and remove the seismically unfit Scott Dam on the Eel River and replace the Cape Horn Dam with a fish-friendly water diversion for Russian River communities. These dams that are owned by Pacific Gas & Electric Company block salmon access to 288 miles of pristine upper watershed habitat in the Eel River. Removal would likely make the Eel the longest free-flowing river in California and could contribute to water supply reliability for communities along the Russian River. The company has decided to decommission its facilities. By the end of 2024, complete negotiations with Pacific Gas & Electric Company and finalize this agreement and secure submission to the Federal Energy Regulatory Commission (FERC) in Pacific Gas & Electric Company's license surrender and decommissioning plan. (CDFW, DWR, CNRA, SWRCB)
- 1.3** By the end of 2024, seek FERC approval to complete design of an engineering solution for maintaining temperatures ideal for salmon on the Feather River high-flow channel downstream of Thermalito Afterbay and to construct a fish segregation weir to secure the low-flow section of the Feather River below Oroville Dam. DWR will establish

the Ecological Committee described in the underlying FERC Settlement Agreement as the group that will select the preferred alternatives to be implemented. (DWR, CDFW)

- 1.4** By the end of 2024, finalize agreements with Yuba Water Agency, National Marine Fisheries Service, and others to construct a new fishway, modernize old diversions, and initiate a salmon reintroduction program on the Yuba River. (CDFW)
- 1.5** By 2025, take the first steps to re-establish spring-run Chinook salmon populations in the North Fork Feather River and the North Fork Yuba River. (CDFW, DWR)
- 1.6** By 2025, begin an evaluation of additional watersheds for feasibility of salmon reintroduction above dams. (CDFW)
- 1.7** By 2025, complete construction of a natural fishway to improve salmon access to the Yuba River above Daguerre Point Dam and restore access to sturgeon. (CDFW)
- 1.8** By 2025, complete at least 10 coastal stream fish passage projects, and by 2026 at least 20 more. (CDFW, DWR, SWRCB)
- 1.9** By summer 2025, complete technical investigations, modeling, and at least 35% design of a project to remove defunct, nearly 100-year-old Rindge Dam from Malibu Creek. With remediation or removal of eight other barriers upstream of Rindge Dam, endangered steelhead could regain 15 miles of spawning and rearing habitat. The reservoir behind the dam is filled with sediment, posing a public safety hazard, and

the dam blocks steelhead migration. Start deconstruction of Rindge Dam no later than 2028. (State Parks, CDFW)

- 1.10** By 2026, secure an approach with Pacific Gas & Electric Company for its Battle Creek Hydroelectric Project to restore volitional upstream and downstream fish passage at the remaining Battle Creek facilities. (CDFW)

POTTER VALLEY

In November 2023, Pacific Gas & Electric Co. gave federal energy regulators its initial plan for removing two century-old dams from the Eel River on the North Coast. Dam removal could reopen hundreds of stream miles of prime salmon and steelhead habitat. PG&E's plan included as an alternative a framework from a regional group backed by CDFW, California Trout, Humboldt County, Mendocino County Inland Water and Power Commission, Round Valley Indian Tribes, Sonoma County Water Agency, and Trout Unlimited. The group's proposal could support ongoing limited water diversions from the Eel River into the Russian River watershed after dam removal. The group is working to refine the proposal and address the interests of Lake County. Dam removal could begin as early as 2028.



1.11 By 2026, complete upgrades to bridges, levees, and infrastructure along Matilija Creek in Ventura County and complete final tasks necessary to ensure removal of Matilija Dam in 2030. This dam-removal project, on a tributary to the Ventura River, will restore steelhead habitat, eliminate a public safety dam risk, enhance riparian and floodplain habitat and property protection, and replenish the Ventura River estuary and Ventura County beaches as a climate adaptation benefit. (CDFW)

1.12 By 2026, implement a strategy to fulfill Senate Bill 857 of 2006, which requires Caltrans to track and remediate all fish passage barriers

to salmon and steelhead habitat caused by transportation infrastructure. Such a strategy may identify and bundle the small transportation-related stream barriers along the California coast into one meta-project with the potential to create advanced mitigation credits for state transportation projects. (CDFW, Caltrans)

1.13 By the end of 2026, start construction to modernize Sunset Pumps on the Feather River and remove its associated rock weir thereby reducing entrainment risk and eliminating a barrier that hinders migration of adult and young salmon. (CDFW, DWR)



The Dutch Slough Tidal Marsh Restoration Project site, located in the Sacramento-San Joaquin Delta near Oakley. The restoration project implemented by the California Department of Water Resources will restore 1,187 acres into a tidal marsh to provide habitat for salmon and other native fish and wildlife. Photo taken May 18, 2023. Credit: Florence Low/California Department of Water Resources.

2. Restore and Expand Habitat for Salmon Spawning and Rearing

Lead Agency:
CDFW

Primary Partners:
Tribal Nations, DWR, Water Boards,
State Conservancies

The pace of restoration lags the scale of threats to California's biodiversity, especially salmon. Most California wetlands have been lost, and large rivers have been disconnected from floodplains. Wetlands and floodplains generate food. Science shows that the more time salmon spend on reconnected floodplains, the more they grow before swimming to the Pacific Ocean. Healthier salmon have a greater likelihood of survival on their journey to the ocean and return home.

In 2022, state agencies broke ground on the 30,000-acre Big Notch Project in the Yolo Bypass, the single largest floodplain rearing habitat restoration in state history. These restoration activities also help recharge groundwater and support migratory birds. Increasing the scale and pace of restoration creates a co-management opportunity with Tribal Nations. For example, an almost \$4 million CDFW grant is supporting a monumental river restoration project on the Trinity River where the Yurok Tribal Fisheries Program's multidisciplinary team of biologists, engineers, and construction experts are completing the Oregon Gulch Project, which is the largest fish habitat construction initiative in the Trinity River's history.

California needs more. Restoration must become a "way of life" for the infrastructure sector as flood control systems are upgraded in the 21st century. The Dos Rios project at the confluence of the San Joaquin and Tuolumne rivers in the San Joaquin Valley is a model for multi-use re-envisioning of land and water systems. River corridors can be expanded to accommodate increased flood control buffers, while making habitat for fish and birds and integrating equitable access to the outdoors or even, where appropriate, solar or other renewable energy projects in expanded buffers.



OREGON GULCH

Hydraulic mining debris has choked the upper Trinity River. The Trinity is the largest Klamath River tributary and once a rich salmon and steelhead spawning river. With nearly \$1 million awarded by the U.S. Department of the Interior and \$4 million granted by CDFW in March 2023, the Yurok Tribe is removing tailings and reconnecting the Oregon Gulch section of the Trinity River to its floodplain. The project will double salmon rearing habitat and help restore riverine forests. The Yurok Fisheries Department's multidisciplinary team of restoration biologists, engineers, hydrologists, and other experts designed the project, and the Yurok Tribe Construction Corporation leads implementation.

Beaver can be important allies in salmon habitat recovery. Salmon and beaver evolved together. Beavers create dams that in many cases allow fish passage while creating deep, cold pools of water that are ideal nurseries for juvenile salmon. For years, salmon restoration programs have supported “beaver analog dams,” where humans add woody debris to North Coast streams to improve salmon habitat. It is time to let nature’s best engineers do some of this restoration work in certain areas around the state.

CDFW and NOAA Fisheries developed a structured decision tool called Salmon Habitat Restoration Priorities, or SHaRP, to use a collaborative, consensus-based process to determine the most pressing habitat restoration actions needed to recover salmon populations in a focus area. Those efforts, which include working with federal agencies, Tribal Nations, and local communities, have led to the identification

of priority actions to restore California’s salmon and steelhead habitat on Lagunitas Creek, Russian River tributaries, the Mendocino Coast, and the Eel River.

In March 2023, the state approved approximately \$22.5 million to benefit salmon and support critical habitat projects statewide. In April 2023, CDFW awarded \$20 million in Drought Emergency Salmon Protection Grants to 10 projects demonstrating support from and collaboration with Tribal Nations and landowner interests in the Shasta and Scott rivers and their watersheds. These include habitat improvement, removal of barriers to fish passage, and groundwater recharge projects that help ensure streamflow. CDFW also awarded \$9 million from the same fund to Tribal Nations in the Klamath River mainstem for post-McKinney Fire debris flow damage remediation, slope and sediment stabilization, and restoration for salmonids.



Funding restoration must be coupled with expediting permitting to get more on-the-ground restoration work done faster. There is no time to waste.

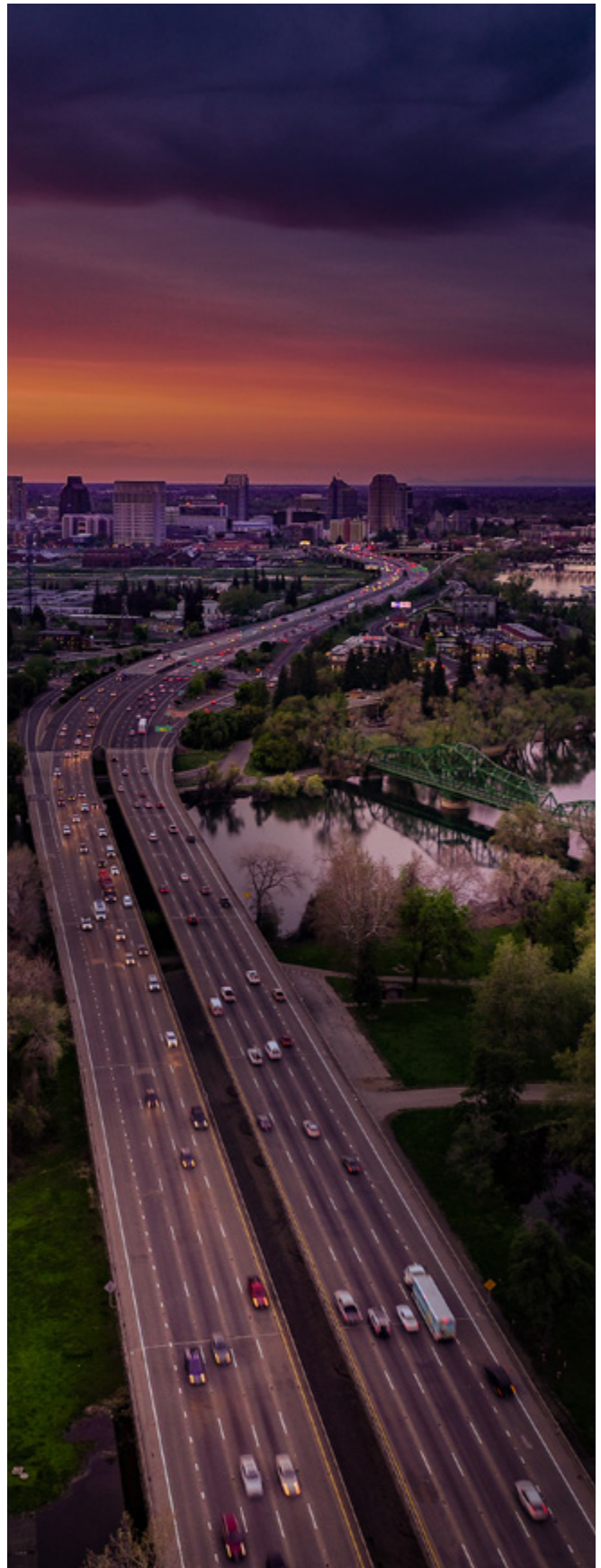
In October 2020, Governor Newsom directed state agencies through Executive Order N-82-20 to “implement actions to increase the pace and scale of environmental restoration and land management efforts by streamlining the State’s process to approve and facilitate these projects.” CDFW is using streamlined permitting and grant-making process improvements to build regional and local organization and government capacity for salmon restoration. The Newsom Administration’s Cutting the Green Tape initiative led by the California Natural Resources Agency helps expand habitat restoration. During FY 22-23, CDFW funded, permitted, or assisted with environmental review exemptions for 217 projects, 18,728 acres, and 477 stream miles saving those projects an estimated \$2.5 million in permitting work with an average processing time of 45 days for permits issued.

Other state agencies have permitted restoration efforts as well, which adds to this total. For example, the State Water Board has completed a general water quality certification for small habitat restoration projects. In August 2022, the Board adopted a Statewide Restoration General Order streamlining permit application and review processes for restoration projects that are too large for the small habitat water quality certification. Since that adoption, the State Water Board has provided expedited approval of 17 restoration projects, 12 of which will have direct benefits to salmon and their habitat. Currently, Water Board staff is expediting the review of 20 more pending applications for restoration projects and is engaged in pre-application discussions with proponents of a number of projects that may file applications in the coming year.

Working together, state agencies and partners will do the following, depending upon available resources:

- 2.1** By the end of 2023, ensure green infrastructure is integrated across and within the Administration’s infrastructure priorities as a nature-based solution. (CNRA, CDFW, DWR, SWRCB, Flood Board)
- 2.2** By the end of 2023, complete beaver translocation efforts at one sentinel location to evaluate feasibility for watershed restoration, and identify a second project for spring of 2024. Beavers can help provide breeding and rearing habitat for aquatic species, sustain cold flows during the summer, and reduce erosion and degradation of spawning habitat. This work will also advance partnerships with Tribal Nations and conservation organizations. (CDFW)
- 2.3** By spring 2024, begin Tisdale Weir fish passage construction and complete construction by fall 2025. (CDFW, DWR)
- 2.4** By the end of 2024, complete at least two additional beaver translocation, watershed restoration projects. (CDFW)
- 2.5** By the end of 2024, identify 20,000 acres that are suitable and feasible for targeted set-back levees projects within the mainstem Sacramento River and major tributaries to restore functional riparian ecosystems. (CDFW, DWR, Flood Board)

- 2.6** By the end of 2024, complete SHaRP documents for coastal Chinook and coho salmon strongholds in the Lower Eel River, Mendocino coastal watersheds, Lower Russian River, and Lagunitas Creek. (CDFW)
- 2.7** By early 2024, increase awareness of Cutting the Green Tape options for salmon restoration projects. Each year between 2024-26, conduct annual workshops about the options and opportunities for restoration practitioners. (CDFW, CNRA, DWR, SWRCB).
- 2.8** By 2025, use Cutting the Green Tape permitting actions to provide reduced timelines for at least 20 salmon restoration projects and another 20 or more projects by 2026. (CDFW, SWRCB)
- 2.9** By 2025, use Cutting the Green Tape permitting actions to address water infrastructure projects to benefit salmon populations. (CDFW, SWRCB)
- 2.10** By 2026, complete planning and permitting processes and initiate construction for at least 1,000 acres of instream habitat for juvenile Chinook salmon rearing and spawning in the Sacramento River mainstem and its tributaries. (DWR, CDFW)
- 2.11** By 2026, modify or reoperate existing water infrastructure to provide seasonal inundation of at least 10,000 acres of floodplain habitat. (CDFW, DWR)
- 2.12** By 2026, create an additional 5,000 acres of floodplain habitat and reconnect salmon to floodplains across the Central Valley. (CDFW, DWR)





3. Protect Water Flows and Water Quality in Key Rivers at the Right Times to Support Salmon

Lead Agency:
SWRCB

Primary Partners:
Tribal Nations, CDFW, WCB, DWR

Salmon go where water flows, and water that is too hot can be lethal to some salmon. Habitat restoration alone will not help salmon without sufficient cold stream flows, which entice returning adult salmon to their natal streams, provide critical habitat for eggs and juvenile salmon to grow, and transport those juveniles to the Pacific Ocean. Without enough cold water juvenile salmon cannot complete their lifecycle and recover and grow the population.

Adequate flows of cold water, including during drought and water shortage conditions, will help protect endangered and imperiled species when they are most at risk. This is no easy task. State agencies can promote, prioritize, and expedite projects that

help augment or protect flows, water temperature, and related habitat.

From now until 2026, the state is investing in hundreds of projects to protect salmon so they can return to their natal spawning grounds and to provide for critical habitat, climate refugia, and wildlife corridors. At the same time, habitat restoration is only effective if there is water for that habitat. Restoration and flow protection go hand in hand to optimize investments for salmon and water supply.



Establishing long-term regulatory instream flows is a multi-step process involving multiple agencies and communities. The State Water Board can do this work as part of water quality control planning and also through water right actions. The process frequently begins with a recommendation for instream flow from CDFW or a federal agency to the State Water Board. The Board must consider those recommendations in light of other competing beneficial uses of water when determining instream flows for the reasonable protection of salmon and other species.

Water quality is also important in protecting salmon refugia; enhancing that quality where possible is an important strategy that California has prioritized (and will continue to do so) through adoption of water quality permits and policies. Recent changes at the federal level regarding definition of wetlands (which can be important salmon rearing habitat) will increase the need for careful consideration and review of water quality in future planning efforts.

The “tool kit” to increase flows, improve water quality, prioritize adequate temperature, and provide baseline protections is diverse. These tools include regulations; water rights action; the legal “public trust” doctrine, which recognizes a public right to natural resources, including aquatic ecosystems; transactions between willing sellers and buyers; infrastructure modernization; water use efficiencies; and coordinated use of water. The state is prepared across several agencies to utilize an “all of the above” approach to provide adequate flows for salmon.

For example, the California Natural Resources Agency is soliciting proposals from water users to make ecologically beneficial flows available in certain streams, with up to \$360 million available for award for contracts, acquisition of water rights, or land tied to water rights. In 2021-22, the Wildlife Conservation



WATER BOARD RUSSIAN RIVER PROGRAM

California's three driest years of record – the drought of 2020-2022 – hit the Russian River watershed early and hard. Governor Newsom declared a drought emergency first in Sonoma and Mendocino counties in April 2021, before the rest of the state. Water users including farmers and cities came together in the upper Russian River watershed to develop a Voluntary Water Sharing Program as an alternative to blanket restrictions on water diversions. Under the program, those with senior water rights could reduce their water use and share with those holding junior water rights. The first-of-its-kind compromise program helped protect flows for Chinook salmon.

Board awarded \$13.8 million in grants to 13 separate projects in Napa, Shasta, Sonoma, Mendocino, Humboldt, Ventura, San Luis Obispo, Siskiyou, and Los Angeles counties to improve environmental flow conditions through landowner actions such as moving diversions from summer to winter, improving groundwater infiltration, and reducing spillage at water diversions and irrigation canals. In the summer of 2022, CDFW executed contracts with Scott River basin alfalfa growers to forego pumping of groundwater to augment flows for coho and Chinook salmon. DWR signed an interagency agreement with the California Rice Commission to compensate rice farmers for flooding their fields for the benefit of shorebirds, waterfowl, and other waterbirds. The State Water Board, acting upon a petition from the Karuk Tribe, began consideration of an emergency regulation in 2023 to set emergency minimum flows for the Scott and Shasta rivers while a longer, inclusive process evaluates long-term strategies for these salmon strongholds.

For the sake of salmon, California also must be prepared to take advantage of heavy rainfall and snowmelt when it occurs. Over 1.2 million acre-feet of groundwater recharge was permitted by State agencies in the winter of 2023, with millions more acre-feet of recharge occurring naturally or through previously developed recharge projects. Replenishment of groundwater reservoirs connected to surface streams can minimize late-summer impacts and improve habitat conditions, because



such efforts can help store and bank water that can be used for people when instream flows are prioritized. Recharge can also help protect streamflow and improve habitat conditions where groundwater and surface water are connected.

Working together, state agencies and partners will, depending upon available resources:

- 3.1** By early 2024, commence work to establish minimum instream flows in the Scott and Shasta Rivers, working with local partners on locally driven solutions and coordinating on options for incentivizing the reduction of diversions and groundwater pumping. (SWRCB, CDFW)
- 3.2** By early 2024, begin review of the Mill, Deer, and Antelope creek instream flow recommendations and use the information to inform a long-term flow-setting process; conduct a scientific basis investigation that compiles the best available science and describes how it relates to flow setting; and develop analysis for a range of flows. (SWRCB, CDFW)
- 3.3** By 2025, continue advancing collaborative work with stakeholder groups to implement flow solutions in Butte Creek. (CDFW)
- 3.4** By 2025, adopt an updated Bay-Delta Water Quality Control Plan, which could include potential Voluntary Agreements to Support Healthy Rivers and Landscapes, to protect beneficial uses including the protection of salmon, steelhead, and other native aquatic species. (SWRCB)
- 3.5** By 2025, complete development of rapid methodologies to establish regional instream flow metrics through the multi-partner California Environmental Flows Framework, which can be used to inform CDFW recommendations and related State Water Board regulatory actions. (CDFW, SWRCB)
- 3.6** By 2025, and thereafter, ensure that groundwater sustainability agencies implement actions consistent with the Sustainable Groundwater Management Act that are directed at depletion of interconnected surface waters and poor river conditions in critical salmon habitats resulting from groundwater over pumping. (CDFW, SWRCB, DWR)

- 3.7** By 2025, where appropriate, revise and modernize approaches for Shasta Reservoir management to protect water quality and temperature management for salmon. (SWRCB, CDFW)
- 3.8** By 2025, revise and implement state and federal permits and Biological Opinions governing the State Water Project and federal Central Valley Project. (CDFW, DWR)
- 3.9** By 2025, ensure the Unified Cannabis Enforcement Task Force (UCETF) is taking action to incorporate salmon protection and illegal cannabis water-related issues as priorities when implementing enforcement actions. (UCETF co-chairs, Department of Cannabis Control, CDFW, SWRCB)
- 3.10** By 2026, complete supply-demand assessment pilot projects in three watersheds to better manage water allocations and provide data for local water management decisions. Expand to at least 12 additional watersheds by 2029. (SWRCB)
- 3.11** By 2026, design and implement an initiative focused on the North Coast – a region well-suited to harmonizing water resiliency, streamflows, and true salmon strongholds – by transitioning communities toward drought-resilient, water-efficient infrastructure such as water tanks, ponds, and off-stream storage and recharge that improve instream flow for salmon. (CDFW, SWRCB)
- 3.12** By 2026, complete instream flow analysis for all streams identified in the 2014 California Water Action Plan, which includes the Ventura River, South Fork Eel River, and Mark West Creek, and eight additional streams of Mattole River, West Fork San Gabriel River, Santa Ana

River, Santa Margarita River, Mojave River, Dos Pueblos Creek, Carpinteria Creek, and North Fork Navarro River. (CDFW)

- 3.13** By 2026, submit these instream flow recommendations to the State Water Board for setting regulatory minimum stream flows. (CDFW)
- 3.14** By 2026, secure voluntary – and, ideally, permanent – transactions of water to improve instream flow conditions in salmon strongholds through local, cooperative agreements, instream flow water purchase programs, and state grants. (CDFW, DWR, SWRCB, DOC)





4. Modernize Salmon Hatcheries

Lead Agency:
CDFW

Primary Partners:
Tribal Nations, Water Boards, DWR,
NMFS, USFWS, BOR

Baird Station, the first national fish hatchery, was established in 1872 on the McCloud River. Today, the Coleman National Fish Hatchery produces Chinook salmon and steelhead to mitigate for the loss of habitat above Shasta Reservoir. The historical era of dam building in California resulted in major hatcheries being constructed to mitigate this massive loss of habitat. Now the California salmon and steelhead hatchery system operated or overseen by CDFW is one of the largest in the world and produces millions of spring- and fall-run Chinook salmon and steelhead every year. These hatcheries are not ready for the future.

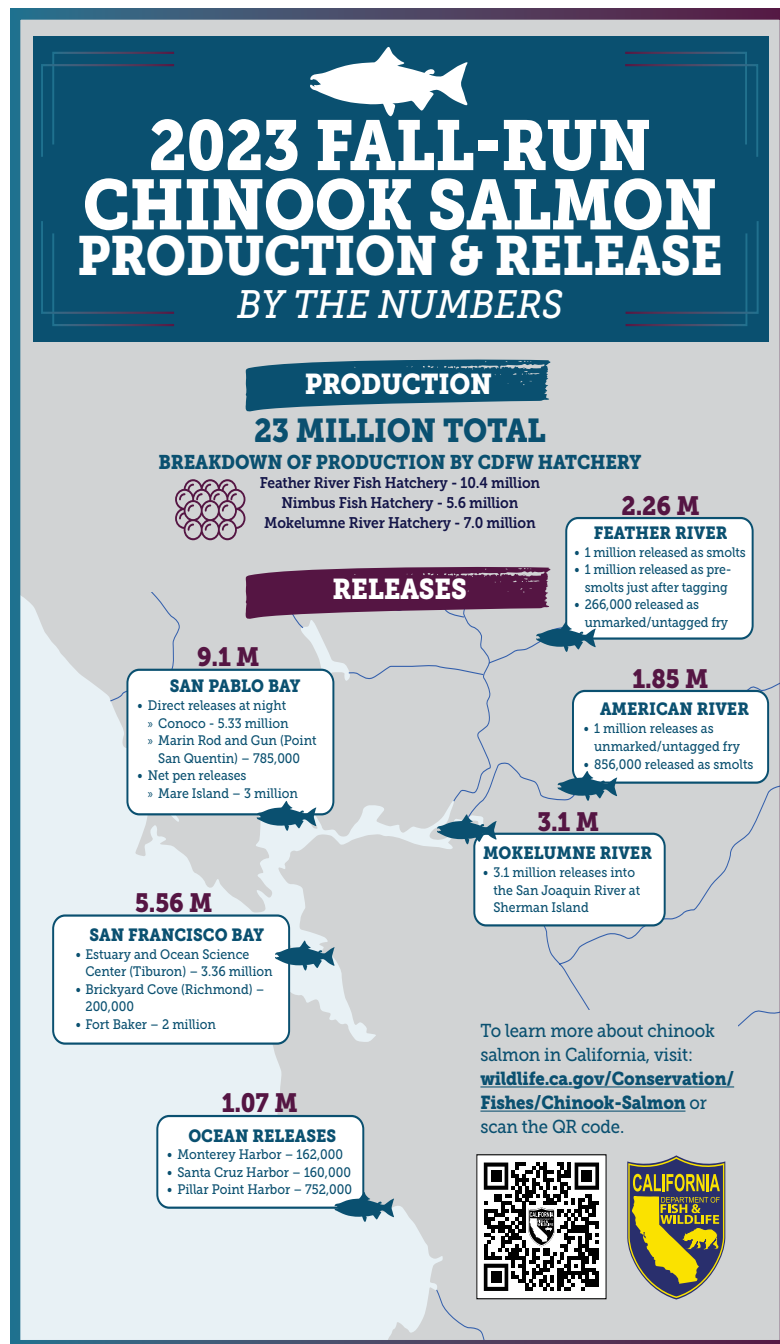
In some cases, a hotter, drier future threatens hatchery water supplies, which need to be consistently cold to ensure fish survival. In other

cases, the hatchery infrastructure dates to the mid-1900s and is prone to failure. Hatchery practices themselves often lag evolving science and fisheries management improvements. The stakes are high, as hatchery practices can affect wild runs of salmon. The best hatchery is a healthy river, but as species move closer to extinction, modernization of hatcheries and the smarter use of them will remain necessary.

Modernization and maintenance of hatcheries is important as climate-driven changes further stress fish and wildlife. CDFW is taking several actions to modernize salmon hatcheries. First, the department launched a comprehensive assessment that will identify the planning and investments needed to build long-term climate resilience for the state's hatchery systems. The assessment will evaluate and provide climate-resilience recommendations for 22

hatcheries and design plans for up to five hatcheries identified as the most likely to have significant climate challenges over the next 20 years. Second, CDFW conducted experimental parental-based tagging (PBT) studies on releases of newly-hatched salmon on the American River. This emerging fish-tagging technology holds the promise of being a large-scale application of genetic parentage assignments, potentially transforming how fish managers determine the age and origin of sampled fish. Third, CDFW conducted smolt releases into the flooded Sutter Bypass to give the young salmon more opportunity to build strength before entering the ocean.

In the last two years, the Newsom Administration invested more than \$84 million in modernization of hatchery infrastructure to improve production and distribution of fish. In 2022-23, CDFW has transported over 15 million hatchery-raised juvenile fall-run Chinook to the San Pablo and San Francisco bays and seaside net pens to increase their rates of survival through intense drought. The state has also committed \$44.5 million towards construction of a Salmon Conservation and Research Facility on the San Joaquin River. The facility will produce spring-run Chinook toward achievement of reintroduction goals on California's second-longest river.



Working together, state agencies and partners will, depending upon available resources:

- 4.1** By early 2024, evaluate further increases of fall-run Chinook salmon production and prepare a plan for hatchery operations in 2024. This plan will prioritize conservation benefits to fall-run survival; mitigation of ongoing drought and other impacts; testing of PBT for one year with related monitoring; and identify a series of work streams between federal and state agencies to develop a long-term technology implementation plan for parental-based tagging and integration into the Pacific Fishery Management Council. (CDFW)
- 4.2** By early 2024, prepare to use emergency transport of hatchery-raised juvenile fall-run Chinook salmon to San Pablo Bay, San Francisco Bay, and seaside net pens more frequently. (CDFW)
- 4.3** By early 2024, use different hatchery production life stages to supplement in-river production. (CDFW)
- 4.4** By summer 2024, complete construction of the San Joaquin Salmon Conservation and Research Facility (SCARF). By 2025, increase spring-run Chinook production at the SCARF facility to one million fish annually. (CDFW)
- 4.5** By 2025, have fully transitioned from the Iron Gate Hatchery on the Klamath River to a new, 21st century facility on Fall Creek. Continue advancing Trinity River Hatchery modernization in collaboration with the Bureau of Reclamation and Tribal Nations. (CDFW)
- 4.6** By 2025, complete a first-ever, top-to-bottom, systemwide climate resiliency assessment of hatchery infrastructure and create a public works plan for modernization, relocation, or construction of new facilities. (CDFW)
- 4.7** By 2026, advance construction or reconstruction of five new state-of-the-art fish conservation hatcheries. (CDFW)
- 4.8** By 2026, install a water treatment system at Feather River Hatchery to facilitate adult salmon movement above Oroville Dam. (CDFW, DWR)
- 4.9** By 2026, continue to implement joint federal-state plans to utilize genetic parental-based tagging strategies to facilitate tracking of adaptively released fish. (CDFW)
- 4.10** By 2026, replace aging hatchery equipment, modernize fish-incubation and rearing enclosures, and replace egg incubators and sorting machines. (CDFW)
- 4.11** By 2026, acquire automated fish counters and pumps and install water treatment systems and chillers at state hatcheries. (CDFW)
- 4.12** By 2026, expand state juvenile fish rearing capacity by 10 million fish. (CDFW)
- 4.13** By 2026, complete necessary Hatchery Genetic Management Plans to ensure any production capacity increase is pursuant to best management requirements to avoid risks to wild salmon populations. (CDFW)



EXTRAORDINARY MEASURES

Mill and Deer creeks in Tehama County support some of the only remaining viable and independent populations of Central Valley spring-run Chinook salmon. Those populations do not depend upon hatcheries. They have been in steep decline since 2015. In 2023, the number of returning adult spring-run salmon hit historic lows. Only seven and 23 fish returned to Mill and Deer creeks, respectively. In October 2023, CDFW and NMFS biologists launched urgent measures to capture juvenile spring-run chinook salmon from Mill, Deer and Butte creeks to start a conservation hatchery program that will safeguard the genetic heritage of the species. UC Davis will house the captive broodstock for the next two years until a longer-term facility is identified. The three streams were once considered a safe stronghold for spring-run Chinook salmon, but local irrigation practices, drought, and climate change have pushed the species to the brink of extinction.



CDFW environmental scientists, along with DWR staff, tag spring-run Chinook salmon at the Feather River Fish Hatchery in Oroville. CDFW and DWR are conducting the tagging in an effort to distinguish between spring and fall-run after the ladders open in the fall. Photo taken May 27, 2022. Credit: Kelly M. Grow/DWR.

5. Transform Technology and Management Systems for Climate Adaptability

Lead Agency:
CDFW

Primary Partners:
Tribal Nations, Water Boards,
DWR, FERC, USFWS, NMFS, USACE,
Counties, Local Agencies

Many salmon management decisions are based on data from prior years, but in a hotter, drier climate, the historical record is not as trustworthy a guide as it once was. Protecting salmon in a changed climate demands 21st century technology and management systems. California's waterways are highly engineered and operated to meet competing needs. Improved forecasting, timely data about streamflow and temperature, rigorous science, and consistent, state-of-the-art monitoring are just as important to the survival of salmon on many waterways in California as they are to ensuring reliable water supplies for cities and farms.



TRANSFORMING TECHNOLOGY

In March 2023, CDFW released 1.1 million fry into the Nimbus Basin, representing the department's first experiment with DNA tagging fall-run Chinook salmon, what's formally known in fisheries circles as "parentage-based tagging" or "PBT." The emerging practice is also being tested at the Coleman National Fish Hatchery near Redding and has been widely used in the Pacific Northwest – but, until March, had never been attempted before by CDFW-operated hatcheries.

Not only are the experimental salmon fry half the age and half the size of typical, hatchery-released salmon smolts, they lack the adipose fin clips to visually identify them as hatchery-origin fish and are also without coded-wire tags that can later provide scientists with information about their life history. Instead, these salmon fry are genetically linked to the parents that produced them in a far less invasive process requiring less human handling.

Three months earlier, on Nov. 29, 2022, CDFW collected and catalogued genetic material (a tissue clip from the caudal or tail fin) from the 500 adult salmon spawned that day at the Nimbus Fish Hatchery used to produce the 1.1 million salmon fry. By collecting future tissue samples from the released fish, CDFW's fisheries geneticists can link every individual back to the Nimbus Fish Hatchery and the exact pair of parents that produced it.

That data could start arriving as early as spring 2024 when CDFW and coordinating organizations begin their downstream monitoring of juvenile salmon in the lower American River, taking tissue samples from young fish collected.

About a quarter of the fall-run Chinook salmon produced at Nimbus and CDFW's other Central Valley anadromous fish hatcheries receive coded-wire tags and adipose fin clips. With parentage-based tagging, however, every individual fish is a potential data source.

CDFW's research will help inform future fisheries management decisions, including the use of parentage-based tagging in coordination with current marking and tagging efforts, and could provide insight into how various release strategies contribute to survival, straying and adult returns.



Climate disruption is also creating new risks to salmon, like the presence of thiamine deficiency in returning salmon runs. Altered ocean conditions may likely be causing the salmon's historical food diet to shift to an unusually high concentration of anchovies, which contain an enzyme that breaks down thiamine in living organisms. Several years ago, CDFW noticed mysterious reactions in young salmon swimming in corkscrew patterns and dying at high rates. Scientific sleuthing pin-pointed this possible factor. Now CDFW treats all hatchery water with thiamine supplement and injects thiamine into hatchery eggs to improve survival rates.

Salmon management systems must factor in climate change effects at a much faster rate to ensure that abundance forecasts, harvest models, and harvest management reflect the best available science.

The federal fishery venue of the Pacific Fishery Management Council must modernize its analytical tools, processes, and harvest approaches. Similarly, existing state statutes should be re-examined and updated where necessary to give state fisheries managers the flexibility and tools to respond to the climate disruption of multiple fisheries including salmon, crab, and urchin.

In 2022-2023, the Governor and Legislature funded CDFW \$1.9 million to replace an aging vessel fleet and to modernize equipment needed to assess the effects of climate change on California's unique biodiversity. The 2022-23 state budget includes an increase of \$23.9 million in 2023-24 and \$2.8 million in 2024-25 to support reactivation and deployment of priority stream gages. More is needed.

Working together, state agencies and partners will, depending upon the availability of resources:

- 5.1** By early 2024, create an executive salmon steering committee within CDFW to coordinate salmon policy and management within and across the department, which would use successful case studies of similar organizational structure for nutria, mountain lion and bear management. (CDFW)
- 5.2** By early 2024, create a salmon strategy implementation team that coordinates salmon projects within CDFW and across state agencies. (CDFW, DWR, SWRCB)
- 5.3** By the fishing season of 2024, implement in-season monitoring to actively manage commercial and recreational ocean salmon fisheries to align with pre-season harvest forecasts. (CDFW)
- 5.4** By 2025, begin to use biological indicators, referred to as biological goals, to inform decision making during implementation of the updated Bay-Delta Water Quality Control Plan. (SWRCB)
- 5.5** By 2025, create a new database to store salmon coded wire tag recovery and scale aging data. (CDFW)
- 5.6** By 2025, evaluate existing state law and regulations and update where necessary to provide for real-time management actions for salmon populations. (CDFW)
- 5.7** By 2025, work with the Legislature and local entities to establish funding and begin implementing recommendations in the Stream Gaging Prioritization Plan 2022, developed pursuant to Senate Bill 19 of 2019. The goal of the plan is to create a network of new and revamped stream gauges to track surface water data on a real-time basis to improve knowledge, increase management efficiencies, and help salmon. (DWR, SWRCB, CDFW, CNRA)
- 5.8** By 2026, create new data assessment tools to improve abundance forecast and harvest models, and evaluate performance of hatchery release strategies. (CDFW)
- 5.9** By 2026, change the status quo approach to tagging and marking fish to increase fine-scale, real-time knowledge and provide database support for tagging and marking methods. (CDFW)
- 5.10** By 2026, achieve the Pacific Fishery Management Council efforts to improve Sacramento and Klamath fall-run Chinook conservation objectives, harvest modeling, and abundance forecasting. (CDFW)
- 5.11** By 2026, improve temperature modeling and information below important reservoirs, including Shasta Reservoir, and engage and coordinate with state and federal agencies to develop temperature management strategies to protect and enhance these runs. (CDFW, SWRCB)



*Michael-Hill Rangel, 5, gets a lesson in fly casting from the Chico Area Flyfishers at the Feather River Fish Hatchery during the 25th anniversary of the Oroville Salmon Festival held in Oroville. Photo taken September 28, 2019.
Credit: Florence Low/DWR*

6. Strengthen Partnerships

Lead Agency:
CDFW

Primary Partners:
Tribal Nations, Water Boards, DWR,
Counties, Local Agencies

Respect for the power and resilience of salmon on the landscape known now as California extends countless generations. Partnerships with Tribal Nations can propel our mission forward. The Klamath River dam removal and river restoration project is proof. CDFW will continue to explore agreements with Tribal Nations as co-managers of critical salmon populations and for reintroduction of salmon into historic habitat.

Tribal Nations and Indigenous Peoples are driving policy and science partnerships. In the spring of 2023, CDFW executed a co-management agreement with the Winnemem Wintu Tribe for cooperative management in McCloud River salmon restoration projects so that traditional knowledge can drive salmon reintroduction. The state can also invest in Tribal Nation-led restoration for salmon. Currently, with state funding support, the Yurok Tribe, the Karuk Tribe, California Trout, Scott River Water Trust, and Farmers Ditch Company are developing a design-build project to restore habitat in the Scott River and improve water diversion infrastructure for on-farm water utilization and efficiency.

Various Tribal Nations in the Bay-Delta region are also providing their knowledge to inform actions to protect salmon and other native species as part of the State Water Board's efforts to update and implement the Bay-Delta Water Quality Control Plan. In response to tribal input, for the first time, the State Water Board proposed including tribal beneficial uses in the Bay-Delta Plan in the September 2023 staff report. That report also incorporates traditional ecological knowledge and includes a commitment to continue to incorporate such knowledge in the planning, implementation, and adaptive management, and science processes for the Bay-Delta Water Quality Control Plan.





TRIBAL PARTNERSHIPS

Winter-run Chinook salmon evolved to spawn in cold waters of the upper Sacramento, Pit, and McCloud rivers north of what is now Redding. Shasta Dam has blocked winter-run for 80 years, and Shasta Reservoir flooded the lands of the Winnemem Wintu Tribe. In May 2023, CDFW, NOAA Fisheries, and the tribe signed agreements to return Chinook salmon to spawning areas above Shasta Reservoir. CDFW awarded a \$2.3 million grant to support the tribe's participation in the potential reintroduction of Chinook salmon that were moved from the McCloud River in California to streams in New Zealand more than 100 years ago. Recovery plans for the species call for an ongoing program of annual transplants of winter-run Chinook salmon to spawning habitat in the McCloud River, where they will be safer from the rising temperatures of climate change.

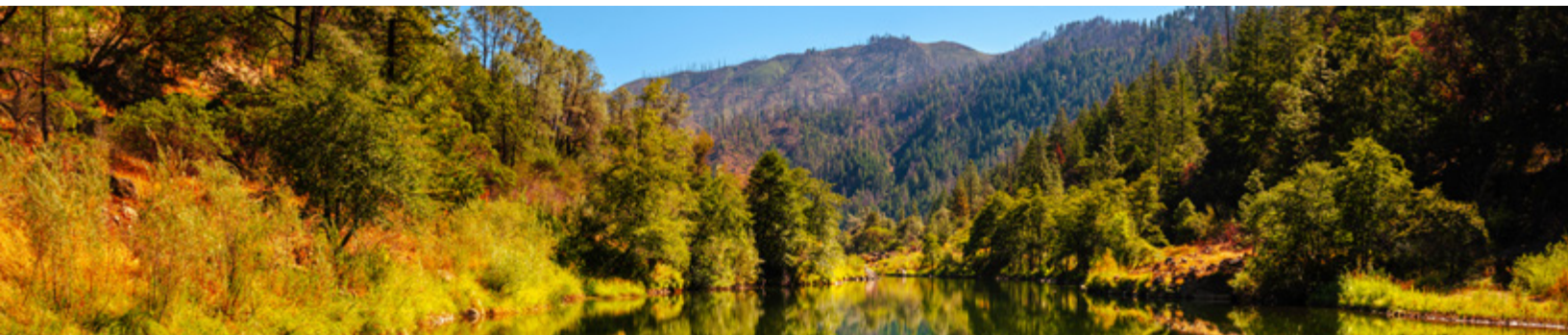


All types of entities that seek to improve salmon habitat and populations across the state are potential partners. For example, partnerships exist that are prioritizing salmon restoration like collaboratives in the Sacramento Valley for winter-run Chinook salmon and for floodplain restoration initiatives. Science collaboratives across water users, state and federal agencies, and conservation organizations are conducting science about temperature-dependent mortality in salmon and improving research on thiamine deficiency in salmon.

It is vital that we also partner with local and state business interests who depend on water resources and salmon. Our business communities are partners in implementation and investment, and it is essential we all work together. While regulatory tools help establish standards, they have limitations and it is vital that the businesses impacted by protective regulations and impacted by salmon loss are also a part of the solutions, from establishing more efficient irrigation practices to implementing best management practices for fishing and protection of water quality to investing in habitat and telemetry. The more collaborative partnerships we can foster, the more effectively we can achieve our goals.

Working together, state agencies and partners will, depending upon available resources:

- 6.1** By early 2024, engage with the United States Geological Survey/Cal Poly Humboldt, California Cooperative Fish and Wildlife Research Unit to conduct critical research on climate change related impacts to salmon. (CDFW)
- 6.2** By early 2024, form a working group with state and federal agencies, salmon industry, water districts, and Tribal Nations to find holistic approaches and strategies to rebuild fall-run Chinook salmon populations in the mainstem Sacramento River. Also, continue and improve current collaboratives like the Sacramento Valley Recovery Program, Reorienting to Recovery project, and Central Valley Salmon Habitat Partnership. (CDFW in close partnership with USFWS and NMFS)
- 6.3** By 2025, develop a regular co-management approach for hatchery operations with Tribal Nations and federal partners consistent with the volitional reintroduction of salmon and steelhead to the upper Klamath River post-dam removal. (CDFW)
- 6.4** By 2025, incorporate Tribal input into efforts to update and implement the Bay-Delta Water Quality Control Plan for the protection of salmon and other native aquatic species, including consideration of the incorporation of tribal beneficial uses into the plan and traditional ecological knowledge into planning and implementation actions. (SWRCB)
- 6.5** By 2025, conduct outreach to Tribal Nations in salmon habitat areas for discussions on cooperative management approaches. (CDFW)
- 6.6** By 2025, further strengthen partnership with UC Davis and Federal Agencies to protect and house juvenile Spring-run Chinook Salmon. (CDFW in close partnership with USFWS and NMFS)
- 6.7** By 2026, enter into agreements with Tribal Nations that wish to memorialize salmon management partnerships. (CDFW)
- 6.8** By 2026, complete key elements of the San Joaquin River Restoration Program to build on the progress of 2019, when spring-run Chinook salmon that migrated as juveniles out of the San Joaquin River returned as adults to spawn for the first time in 65 years. Projects include fish screens, passage structures around dams, and other infrastructure efforts in cooperation with the U.S. Bureau of Reclamation. (CDFW, DWR)





CONCLUSION

The future of California salmon is up to us all. These strategies can help secure salmon populations for future generations – even in a hotter, drier future – and continue their iconic role at the center of religions, creation stories, regional economies, and the health and subsistence of Indigenous Peoples and all Californians.