

Juvenile salmon feast on bugs in enclosed areas of the Yolo Bypass during a 2014 experiment in a flooded rice field.
PHOTO BY CARSON JEFFRES/UC DAVIS

WATER

FLOODPLAIN FATTIES: A NEW PARADIGM FOR SALMON — AND DUCKS?

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Before the American settlement of California, the Central Valley would flood every year in the winter and spring. Four million acres of wetlands would appear as the snowmelt overflowed the banks of the Sacramento and San Joaquin rivers and their tributaries. Tulare Lake at the south end of the San Joaquin Valley was the largest freshwater lake west of the Mississippi River. These wetlands served as the winter home for tens of millions of migrating ducks, geese and other birds on the Pacific Flyway. The rivers would swarm with salmon, returning upstream to spawn.

With the arrival of the Americans, especially after the Gold Rush of 1849, the rivers were polluted by hydraulic mining and constrained by levees to reclaim the rich soil of the wetlands. Tulare Lake was drained and converted to farmland. The waterfowl were reduced from tens of millions to millions. California Waterfowl is dedicated to maintaining the wetlands that are left as habitat for the birds.

Like waterfowl, salmon have been severely impacted by the “reclamation” of floodplains for agriculture, mining, logging, hydropower dam construction, urbanization and other land uses in California. Millions of wild salmon used to return to spawn in rivers and creeks flowing through California’s valleys and foothills.

The State Water Project and the federal Central Valley Project use huge pumps in the Sacramento-San Joaquin River Delta to move water to Southern California and to farms in the San Joaquin Valley. These pumps can reverse the flow of water from the San Joaquin River and guide young salmon into the forebay for the pumps, where predators lie ready to eat them.

Sacramento River winter-run Chinook salmon are listed under the federal Endangered Species Act. Central Valley spring-run Chinook salmon and Central Valley steelhead are listed as threatened, as well.

Various state and federal agencies including the federal NOAA Fisheries, U.S. Fish and Wildlife Service and the state Department of Fish & Wildlife have been trying for many years to prevent the continued decline of the salmon populations. Other local agencies, such as irrigation and water districts, have also been carrying out projects to improve habitat conditions for migrating salmon.

The state and federal government, as well as local water districts, have spent billions on removing dams, installing fish screens and trucking stranded salmon. The Central Valley Project Improvement Act set aside 800,000 acre feet of water per year for seasonal flows intended to protect salmon.



These two salmon smolts are the same age. The one on top grew up in the Sacramento River; the one on bottom grew (and grew and grew and grew) in a floodplain as part of the Nigiri Project conducted by CalTrout and UC Davis. PHOTO BY CARSON JEFFRES/UC DAVIS

Under an order issued by the Federal District Court in Fresno in 2008, billions of gallons of water that would otherwise have been delivered to farmers and Southern California water agencies that contracted and paid for the delivery have been diverted to the Pacific Ocean with the intention of preventing the extinction of the winter and spring salmon runs. This has been the impetus for the project that would run two tunnels under the Delta to avoid the reverse flows caused by pumping.

To hatch their eggs, salmon require cold water on the spawning grounds below Shasta Dam. They also require sufficient flows in the river to cover the gravel beds (“redds”) in which the eggs are deposited. Finally, they require enough water in the mainstream of the river for the young, known as “smolts,” to make their way to the San Francisco Bay, the Golden Gate and out to sea.

Water flows in the Sacramento and San Joaquin rivers are relied upon by many users. Southern California relies heavily on the State Water Project for a large portion of its water supply. Sacramento Valley and San Joaquin Valley farmers rely on the Central Valley Project to irrigate the most productive agricultural region in the world. The preemption of water flows to protect listed salmon species has imposed enormous costs on the state through lost productivity and cutbacks on urban water supplies.

Farmers are not able to plant crops, or they overdraft groundwater supplies to keep their trees alive. Water districts in Southern California that pay hundreds of millions of

dollars for water whether the state can deliver it or not, have to impose shortages on their customers and are unable to recover their costs from rates. In the Sacramento Valley, rice farmers have difficulty receiving water at the times when they need it. When wildlife refuges are cut back, they are unable to irrigate to provide food for arriving waterfowl, and sometimes they need to delay opening for duck season because they lack water in the fall.

Despite the enormous amounts of money, water and effort that have been dedicated to salmon, the fish have failed to thrive and increase in population.

Almost every year, scientists make dire predictions that winter-run salmon are on the verge of extinction. Too few fish make the journey all the way to the Golden Gate. Most either die before they are born or are eaten by predators in the Delta. The investments in flows, dam removal, screens and other efforts to protect the fish just don't seem to make more than a marginal difference.

Within the last 10 years, however, scientists have discovered that salmon smolts that are able to get into flooded areas out of the mainstream of the river grow much faster and are better able to survive the trip to the ocean. The relatively quieter and warmer water in floodplains allows the growth of invertebrates, insect larvae and other small creatures that provide a rich source of food for the smolts.

It appears that merely providing the smolts with clear, fresh, cold water leaves them without nourishment, which they need to grow and to have the strength and size to avoid predators and swim out to the oceans. Well-nourished smolts have a much greater chance of survival.

In 2011, CalTrout scientists, along with scientists from the University of California, Davis, conducted a pilot project on the Knaggs Ranch, north of Interstate 5 on the west side of the Sacramento River, in the Yolo Bypass.

The Yolo Bypass is designed to flood when the Sacramento River reaches levels that threaten the city of Sacramento. It provides habitat conditions that are similar to those that existed before the reclamation of the floodplains.

The needs of waterfowl and salmon still need to be reconciled so that the two species can thrive in harmony.

On a test plot of five acres on the Knaggs Ranch, the CalTrout and UC Davis scientists showed that, given an adequate nutrition source, smolts tripled in weight over six weeks. Smolts in the river did not gain weight at all.

The smolts in the project were far more likely to survive predation and stress on their way out to the ocean.



Photo by Magone/iStock

Another pilot test in 2013 involved 50,000 smolts on 20 acres of flooded rice fields. Again, the results were astonishing. The smolts were dubbed “floodplain fatties.” The project gained the name “Nigiri Project.” Nigiri is a Japanese term for sushi that features fish over rice.

Since 2013, the project has expanded to 2,500 acres in the Yolo Bypass. The scientists are experimenting not just with nutrition, but with the effects of longer time spent before going out to the ocean and with finding a better, safer route out to the Delta.

There are a number of difficulties yet to be addressed. Only 5 percent of the original floodplain still exists in California, mostly in the San Joaquin Valley. There are technical difficulties in putting fish onto and off of the floodplains. Most areas adjacent to the river are behind levees and have irrigation structures that are not fish-friendly.

Although the Yolo Bypass floods in most years, much of it now consists of duck clubs. It is a major waterfowl wintering area. The conditions and timing of flooding that salmon might require may be different than those needed by waterfowl. The needs of waterfowl and salmon still need to be reconciled so that the two species can thrive in harmony.

On the whole, the Nigiri Project shows great promise. It may lead to an increased emphasis on restoring and maintaining wetlands, which could be good for waterfowl as well. It will certainly make a good argument for the winter flooding of rice, which is done now for air quality reasons, but provides a very good food resource for waterfowl.

Another means of improving conditions for out-migrating salmon may be to drain rice irrigation water directly into the river. This will provide the nutrients they need, although not as well as putting the fish into the floodplains. An additional benefit of draining rice fields into the river is that Delta smelt, another critically endangered fish species, have been shown to respond to the increase in nutrients.

This change in the paradigm for salmon survival opens the possibility of restoring healthy salmon stocks to the rivers and removing the endangered and threatened status of the winter-run and spring-run populations. If a way can be found to provide the smolts with the nourishment they need, flows might eventually be restored to agriculture and urban uses. The emphasis on restoring and maintaining wetlands could benefit waterfowl, if their needs can be reconciled with the needs of the fish.

The change in paradigm from flows to floodplains can have many benefits. From restoration of fish populations to waterfowl to agriculture to flood control to reliable urban water supplies, there are many exciting prospects. The Parks Bond on the June ballot (Proposition 68) and the Water Bond on the November ballot will have funding available to help move all these benefits forward. 🙌



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