Salmon and Steelhead in the American River

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What kind of fish are in the American River?

The American River provides habitat for *native* and *non-native* fish. *Native fish* are specially adapted to conditions in Northern California's inland rivers. Common native fish in the American River include Sacramento sucker, Sacramento pikeminnow, hardhead, Sacramento tule perch, Central California roach, Santa Ana speckled dace, prickly sculpin, hitch, Sacramento splittail, mosquito fish, Pacific lamprey, rainbow trout, green and white sturgeon, steelhead, and several varieties of salmon (http://calfish.ucdavis.edu/species/).

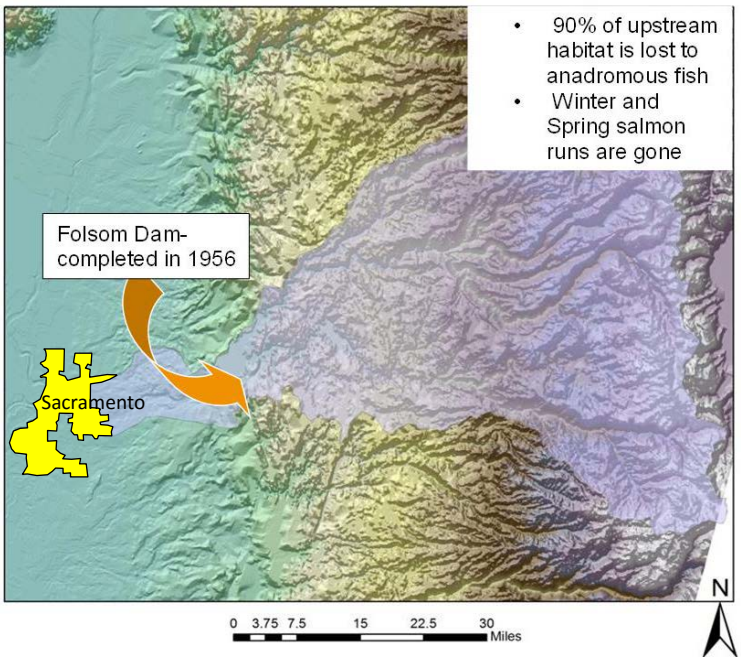
Non-native fish species were introduced to the area by early travelers, sports-fishers, and the shipping industry. Non-native fish are adapted to different conditions, and sometimes out-compete local species. Non-native fish in the American River include striped bass, brown trout, American shad, catfish, crappie (black and white), bluegill, western mosquitofish, smallmouth bass, largemouth bass, bullhead, redear sunfish, grass carp, goldfish, Sacramento perch, Mississippi silversides, and stickleback (http://calfish.ucdavis.edu/species/).

Salmon and Steelhead in the American River

All fish are important in the larger ecosystem, but salmon and steelhead have special meaning for humans. Native Americans have celebrated the return of the salmon for thousands of years, and today, salmon fishing is a huge industry in California. These iconic fish are also indicators of the health of the ecosystem, and our local salmon populations are struggling.

Some fish in the American River are *anadromous*. This means they spend a significant part of their life in the ocean, then return to their original freshwater river to spawn. Anadromous fish in the American River include Pacific lamprey, steelhead, and salmon.

Salmon have faced many challenges in the American River. The gold rush era changed the river so dramatically that salmon were temporarily eliminated in the late 1800's, but they returned. More recently, Folsom and Nimbus Dams have prevented anadromous fish from reaching the upper parts of the watershed. Approximately 90% of the upstream habitat is currently blocked by dams. When the dams were completed in 1956, several salmon runs were lost on the American River. We no longer have runs of late fall-run Chinook salmon, winter-run Chinook salmon, and spring-run Chinook salmon (Williams, 2006). The only remaining runs are fall-run Chinook salmon and steelhead. These runs survive because Nimbus Hatchery creates millions of juveniles each year. Some natural spawning also occurs in the six miles of gravel-bed river that lie directly below Nimbus Dam.



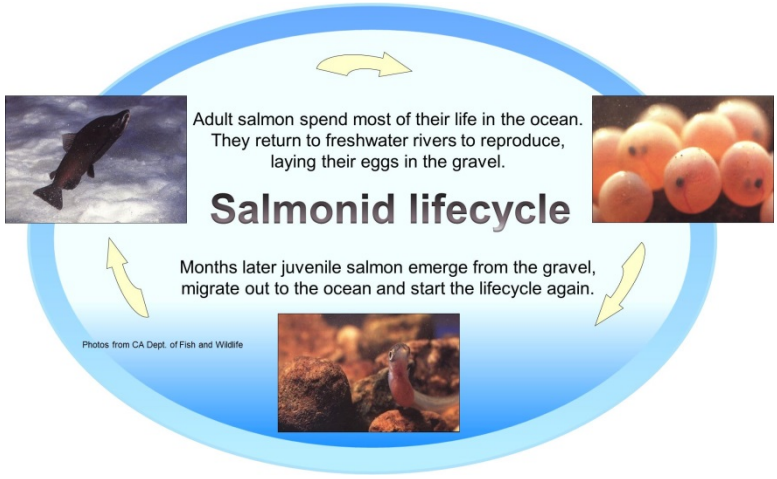
The American River watershed is outlined in purple. Access to the upper watershed was eliminated in 1956 when Folsom and Nimbus Dams were completed.

The large silvery or dark green fish that we see in the American River are mostly **Chinook salmon**, named after Native People of the Pacific Northwest. Another common name for this iconic fish is king salmon, and biologists refer to them by the Latin name *Oncorhynchus tshawytscha*. Other types of salmon (coho, sockeye, and chum) occasionally find their way into the American River, but they make up a very small percentage of the total. Most adult salmon return to spawn when they are two or three years old, and all die after spawning. Large salmon runs on the American River can reach 50,000 – 100,000 adult fish. The peak season for adult salmon on the American River is usually the second or third week of November.

Steelhead or **steelhead trout** are close relatives of salmon, but they are less common in the American River. Steelhead are ocean-going versions of rainbow trout, and they may make several trips from the ocean to spawn in their native freshwater river. The Latin name for steelhead is *Oncorhynchus mykiss,* and they are listed as a threatened species by the California Department of Fish and Wildlife. The number of naturally spawned adult steelhead in the American River has been as low as 300 in recent years, and fishing "take" is limited to hatchery fish to preserve the wild strain. Juvenile steelhead are especially susceptible to stress-induced bacterial infections, and warm water makes this condition worse. The peak season for adult steelhead on the American River is usually the second or third week of January.

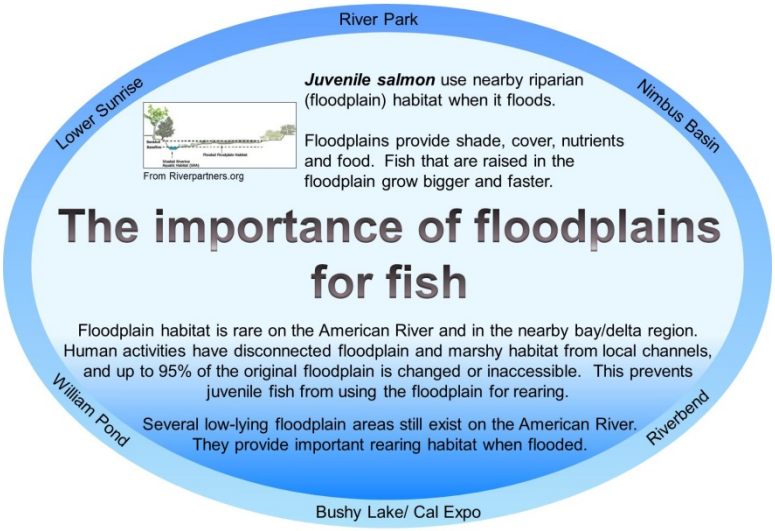
Salmonid lifecycle

Adult salmon spend most of their life in the ocean, and return to freshwater rivers to reproduce. Salmon ***eggs*** develop in the river gravel, where they are deposited by the female. The female salmon builds a redd, or nest, in the gravel, and her male partner fertilizes the eggs as she buries them. Eggs hatch after four to six weeks depending on temperature and dissolved oxygen content. Juveniles use the yolk sac from the egg as a food source, and are called ***alevin***. When they begin to feed independently, they are called ***fry***. Fry feed on aquatic insects and phytoplankton, and may remain in the freshwater river for months. When fry prepare for life in the ocean, they go through physiological changes that adapt them for life in salt water. Juvenile salmon in this transitory life stage are called ***parr***. Salmon that live in the open ocean are finally ***adults***, and they migrate long distances in search of krill and small fish (Groot and Margolis, 1991; Ward and Taylor, 2007). Adult salmon spend several years in the ocean before returning to freshwater streams to spawn and start the lifecycle again.



Why are floodplains important to fish?

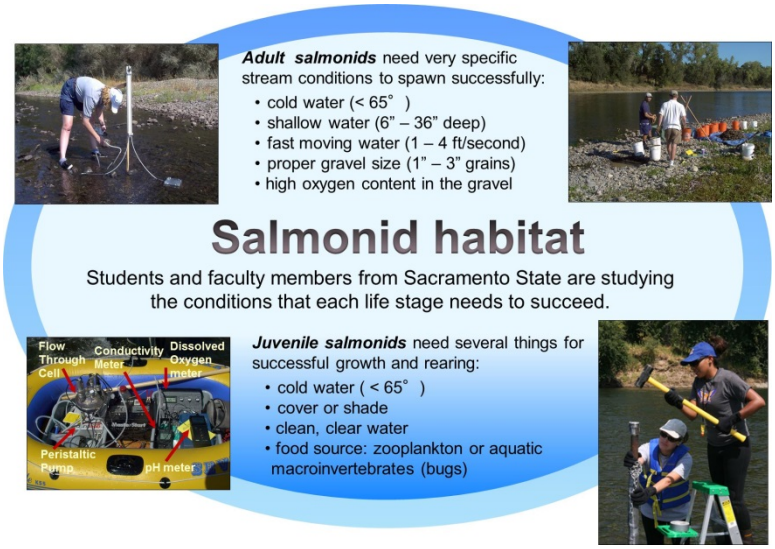
Healthy rivers need healthy floodplains. The floodplain is the low-lying area near the river that floods during high flow events. Flooding is natural and can benefit the ecosystem. Winter storms and spring snowmelt push the American River over its banks, covering the floodplain with shallow, muddy water. This delivers nutrients to the floodplain, and can provide important habitat for juvenile fish.



Habitat Requirements – What Salmon Need

Team members from Sacramento State are studying the conditions that each life stage needs for success. They monitor physical conditions that affect adults, eggs, and juvenile salmon and steelhead. The monitoring program measures:

- Gravel size and condition
- Dissolved oxygen content
- Surface water depth, velocity
- Water temperature
- Shade and cover
- Fish use



These measurements help identify areas of the river where spawning is successful and other areas that may be restored or improved to promote in-stream reproduction.

River Restoration Projects – What happens when gravel is added?

Gravel size is often the single largest limitation to successful spawning in the American River, although flow and temperature are also issues. Gravel beds have become coarser in the American River since dams were constructed, because high flows have washed away the finer material (Fairman 2007). In many parts of the river, the surface is armored with boulders that are too heavy for the female fish to move when she tries to construct a redd. Salmon need gravel that is larger than a marble (1/2") and smaller than a softball (4") for successful spawning. When we add appropriate-sized spawning gravel to the river, more natural spawning occurs.

Large collaborative projects have improved spawning and rearing habitat at seven sites on the American River. This work began in 2007 and continues today as a result of commitments from the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and Sacramento Water Forum. These projects go through planning, permitting, construction, and monitoring phases.

During construction, gravel from nearby gravel bars is cleaned and sorted. Many of these gravel bars are piles of dredge tailings, part of our gold mining legacy.

Dredge tailings are tested for heavy metal content, sorted, washed, and moved to the river's edge. Skilled heavy equipment operators place the gravel in the river channel to produce the right depth, velocity, and grain size for salmon spawning. Juvenile rearing habitat is also enhanced by improving access to floodplains and side channels.

Gravel restoration projects increase natural spawning.

Restoration projects produce immediate results. Observers have seen adult salmon spawning on restoration sites days within days of construction, and physical conditions have improved at all sites. A comparison of conditions before and after restoration shows these changes:

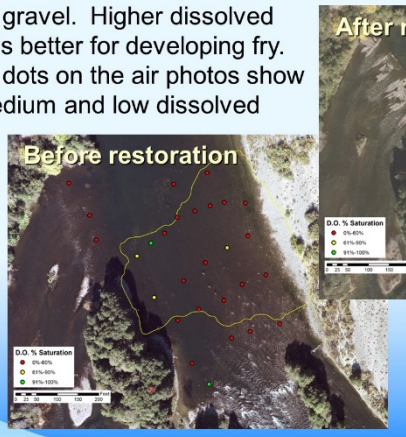
Gravel size is smaller—female fish can move the gravel and construct redds.

Dissolved oxygen increases in the new gravel—this helps eggs develop.

Permeability increases—this allows oxygen to flow to the developing eggs.

Water depth and velocity improve.

Dissolved oxygen content is higher in the new gravel. Higher dissolved oxygen is better for developing fry. Colored dots on the air photos show high, medium and low dissolved oxygen.



Spawning use is higher in the new gravel. Dots on the air photos indicate salmon redds (nests) in the river.

Gravel restoration sites have more redds.

And the most important change: salmon use the new gravel!

Thanks to our Agency sponsors and partners

Sacramento State students gain real-world experience by monitoring the restoration sites. Our agency sponsors and industry partners include:

U.S. Bureau of Reclamation, Sacramento Office
CA Department of Water Resources (Oroville Office)
City of Sacramento Water Forum
CA Dept. of Fish and Wildlife
CBEC Engineering
Cramer Fish Sciences

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