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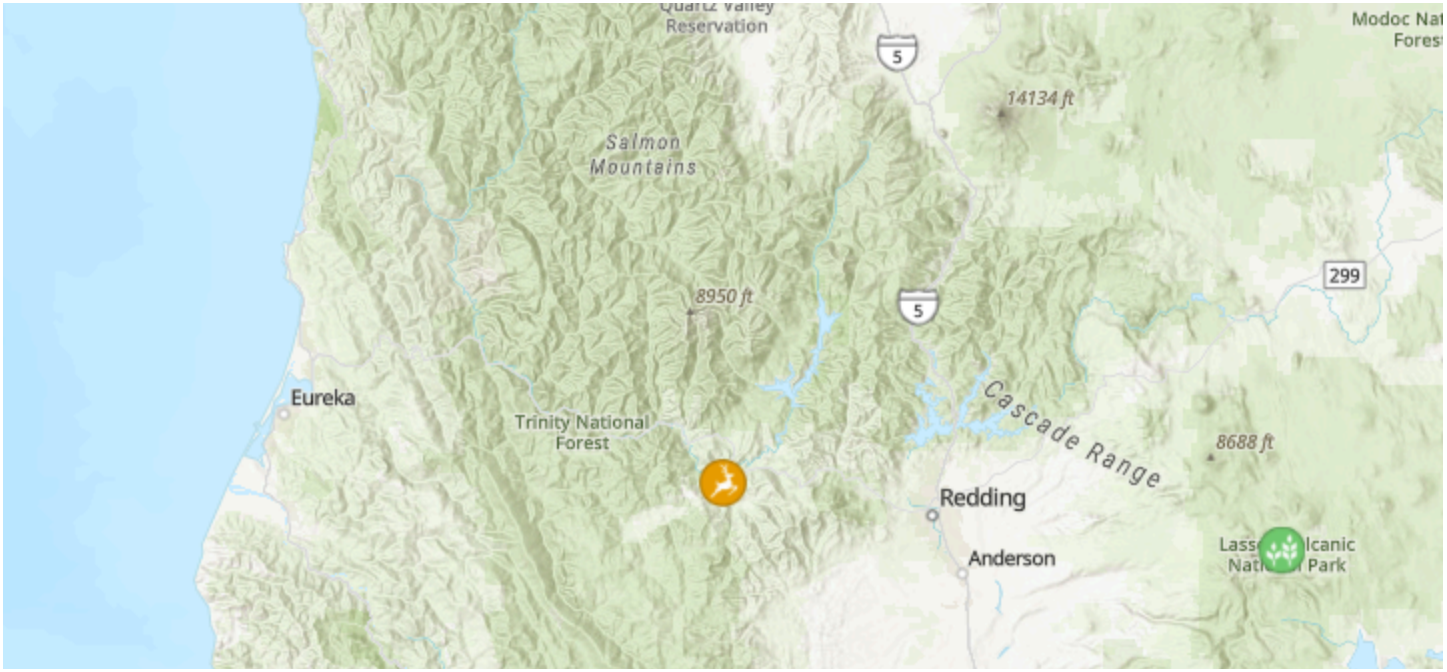
Adaptive Management in Action: The Trinity River Restoration Program

A Case Study on Restoration
February 29, 2024



Introduction

The Trinity River flows for 700 miles from the Trinity Alps in northwestern California to the Pacific Ocean. This river once supported populations of fall- and spring-run Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), and steelhead (*Oncorhynchus mykiss*). The spring-run Chinook salmon is listed as threatened by the state of California, while the coho salmon is listed on the federal and state Endangered Species Act (ESA) as threatened. The Trinity River basin has provided the Hupa and Yurok Tribes with fish, plants, and animals for subsistence as well as for cultural, ceremonial, and commercial purposes for thousands of years. Estimates from

the 1950s suggest that prior to damming Trinity Lake, between 19,000 and 75,500 fall-run Chinook salmon returned to the river each year (TRRP). Seasonal floods refreshed the gravel where salmonids lay their eggs by bringing in new material and clearing sediment, and opened deep pools needed for cover and refuge. However, starting with the discovery of gold in 1848, human activity degraded salmonid habitat throughout the Trinity River Basin. Hydraulic mining, followed by industrial logging, and then water diversion from dam projects of the 1960s, resulted in extensive declines in salmon and steelhead populations.

In 1984, Congress passed the Trinity Basin Fish and Wildlife Act that established the Trinity River Basin Fish and Wildlife Task Force (now Trinity Management Council, TMC) to study the basin and make recommendations for its recovery. In 1999, the U.S. Bureau of Reclamation, Hoopa Valley Tribe, U.S. Fish and Wildlife Service, and other agencies completed the Trinity River Flow Evaluation Study and Environmental Impact Statement (EIS). The TMC established the Trinity River Restoration Program (TRRP) in 2000 to restore naturally-spawning salmon and steelhead populations to pre-dam levels using preferred strategies from the EIS.

The TRRP benefits from a consistent and secure source of funding through the Bureau of Reclamation; the majority of the project is funded by Reclamation, with 83% of that funding from the Water and Related Resources Account and the rest from the CA Central Valley Project Improvement Act Restoration Fund. As

a result, the TMC has been able to oversee more than two decades of river projects that are continually adapted to reflect monitoring results, research, and new science. The TRRP is a living laboratory for large-scale river restoration using adaptive management techniques.

Key Issues Addressed

After dam construction on the Trinity River, flows were reduced from thousands of cubic feet per second (cfS) to hundreds of cfS, with major releases in May and June. Post-dam water temperatures are warmer in the winter and colder in the summer, and there is a sudden and unnatural temperature drop during the spring release. Monitoring indicates these changes may result in reduced coho egg survival and reduced growth rates of Chinook fry. It may also delay outmigration of smolts (fish in the salmonid developmental stage where they are becoming larger and stronger). Delayed outmigration increases the risk that smolts will be infected with the lethal pathogen *C. shasta*.

Damming also impacted the gravel beds which adult salmonids need for spawning. River gravel provides habitat for insects and serves as the raw material from which the river rejuvenates itself. Much of the spawning gravel was scoured away after impoundment as water releases transported gravel downstream without simultaneously replenishing gravel as would have happened before the dams. The remaining gravel beds were choked with sand, which reduces the survival of eggs and fry.

No longer subject to the pre-dam seasonal flooding which spread water throughout the basin and carved new channels and renewed vegetation, the banks of the Trinity River became densely vegetated and the streambed no longer held woody debris to create habitat for various life cycle requirements of the salmonid population.

Rivers like the Trinity that support adequate salmonid habitat are imperiled throughout the Western U.S., largely as a result of human impacts like dams, mining, logging, and urbanization. There have been over 4,000 river restoration projects in California since 1980, but systematic and objective assessment of completed projects as a method to inform next generation river restoration is often lacking (Kondolf, 2007). Many restoration programs do not have the resources to conduct long-term monitoring and apply that data to improve outcomes for the species being targeted.

Project Goals

- Restore and sustain naturally spawned anadromous fish populations for commercial, Tribal, and sport fishing.
- Restore form and function of the Trinity River and its riparian area by using adaptive management strategies including variable flow management, streambank restoration, and riverbed improvement.

Image Caption: *Juvenile Chinook Salmon (Oncorhynchus tshawytscha). Courtesy of Ken DeCamp.*

Project Highlights

NO STONE LEFT UNTURNED	PIT (Passive Integrated Transponder) tags were placed in gravel augmentation sites, allowing the TRRP to measure where gravel moves and adjust gravel amendment accordingly.

- **The Power of Water:** Water–when, how fast, where–is the primary tool the TRRP can use to improve habitat. For example, sediment deposits are critical for refreshing the riverbed, sandbars, and islands. In the first years of TRRP monitoring, results showed that during a five-day peak flow, most sediment movement happens in the first day. With this information, the TRRP was able to shorten the peak flow without affecting sediment deposit, allowing more water for other release phases and restoration practices, such as recruitment of cottonwood and other woody riparian plants during the recession phase.

- **Timing the Flow:** Monitoring indicated that water releases in May and June were too late for smolts' development. This disconnect between when water is needed and when water is flowing reduces the number of smolts making it through to migration. Based on the data collected over the past twenty years, the TMC is releasing water earlier to better support the smolt stage of the salmonids in the spring.

- **Slowing the Flow:** The TMC prescribed flatter spring recession rates (how spring flows are gradually decreased) as a result of riparian tree recruitment monitoring results. Monitoring of transects along the river showed that key riparian hardwood tree species were recruited with a flatter recession rate, which reflects a natural river's snowmelt hydrology.

- **Rocking the River:** The earliest gravel amendment projects deposited large amounts of gravel upstream in hope that river flows would adequately disperse the substrate. Sediment monitoring showed that this method did not achieve effective distribution of the gravel. Instead the TRRP now distributes gravel across five amendment sites in the project area.

- **Scaling Up for Bigger Benefits:** The original TRRP Adaptive Management plan designated 47 sites along the river for restoration. This large number of potential sites has allowed managers to apply monitoring results from the initial sites to more recent projects. For example, berm removal 20 years ago to connect the floodplain and river did not have a significant impact on juvenile survival rates. Newer research indicates that salmonid habitat requires complex re-engineering of the entire riverbed. TRRP riverbed and revegetation projects have become much more comprehensive, including realignment of the streambed, creation of main channel alcoves, side channels, woody structures, and installation of beaver dam analogs.

Image Caption: *New side channel constructed at the Oregon Gulch Restoration Site. Courtesy of Max Ramos, Yurok Tribal Fisheries Department.*

Lessons Learned

The TMC built funding for monitoring into the program from the beginning, continually investing in measuring outcomes that support data-informed decisions for subsequent restoration. The TRRP considers data collection a critical investment in the success of the program, and it has paid off. Data shows salmonid numbers are increasing due to improvements in restoration

projects over the past ten years compared to the first ten years of the program.

A restoration program of this magnitude requires advocates who provide support and continuity throughout the life of the program. The Yurok and Hoopa Valley Tribes elevate the health of the Trinity River and its salmonid population to more than just a conservation or environmental issue. Their reservations are located downriver, they are salmon people, and this is their ancestral home and river. They have staff in the TRRP office in the basin and many Tribal members are trained specifically in river restoration engineering and construction. The consistency of this specialized workforce means that resources can be directed towards projects instead of training new staff every few years.

The TRRP has amassed a significant amount of publicly-available data on best management practices in salmonid habitat restoration through river basin management. These data are a valuable resource for other river restoration programs, especially those without the resources to conduct their own long-term monitoring.

The multi-agency partnership allows flexibility in adapting various approaches to management. The Tribal offices are better able to collaborate with researchers on the river, while the federal agencies are better able to access federal monies for restoration work. Getting the whole TMC membership on board in decision making can take time, and agreeing on objectives moving

forward as a result of collected data can be a process itself. All of these factors should be considered in an adaptive management conservation strategy.

Image Caption: *Yurok Tribal Employee Monitoring on the Trinity River. Courtesy of Yurok Tribal Fisheries Department.*

Next Steps

- Continue to work towards varying Lewiston Dam releases during the late winter and spring Chinook salmon rearing period
- Conduct analysis of survival across all life stages for Chinook salmon to identify population bottlenecks
- Continue to implement channel rehabilitation projects that incorporate lessons learned from past projects
- Fund restoration projects in Trinity River tributaries
- Complete an environmental assessment (NEPA) for large wood and sediment augmentation, increasing the number of sites where TRRP is approved to augment both

Image Caption: *Bucktail Restoration Site showing the impacts of Beaver Dam Analogs slowing waters. Courtesy of Kiana Abel, Bureau of Reclamation.*

Resources

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Collaborators

- CA Department of Fish and Wildlife

- CA Department of Water Resources
- U.S. Fish and WIldlife Service
- U.S. Bureau of Reclamation
- U.S. Forest Service
- National Marine Fisheries Service
- Trinity County
- Hoopa Valley Tribe
- Yurok Tribe

Funding Partners

- U.S. Department of the Interior

Resources

- Lee, James. *Trinity River Restoration Program's Adaptive Management Program*. March 2023. Powerpoint Presentation.
- Trinity River Restoration Program

Photo Gallery

- Photo Album and Credits

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Image Caption: *Adult Chinook Salmon (Oncorhynchus tshawytscha). Courtesy of Ken DeCamp.*

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