Scott River Tributary Fish Passage and Refugia Enhancement

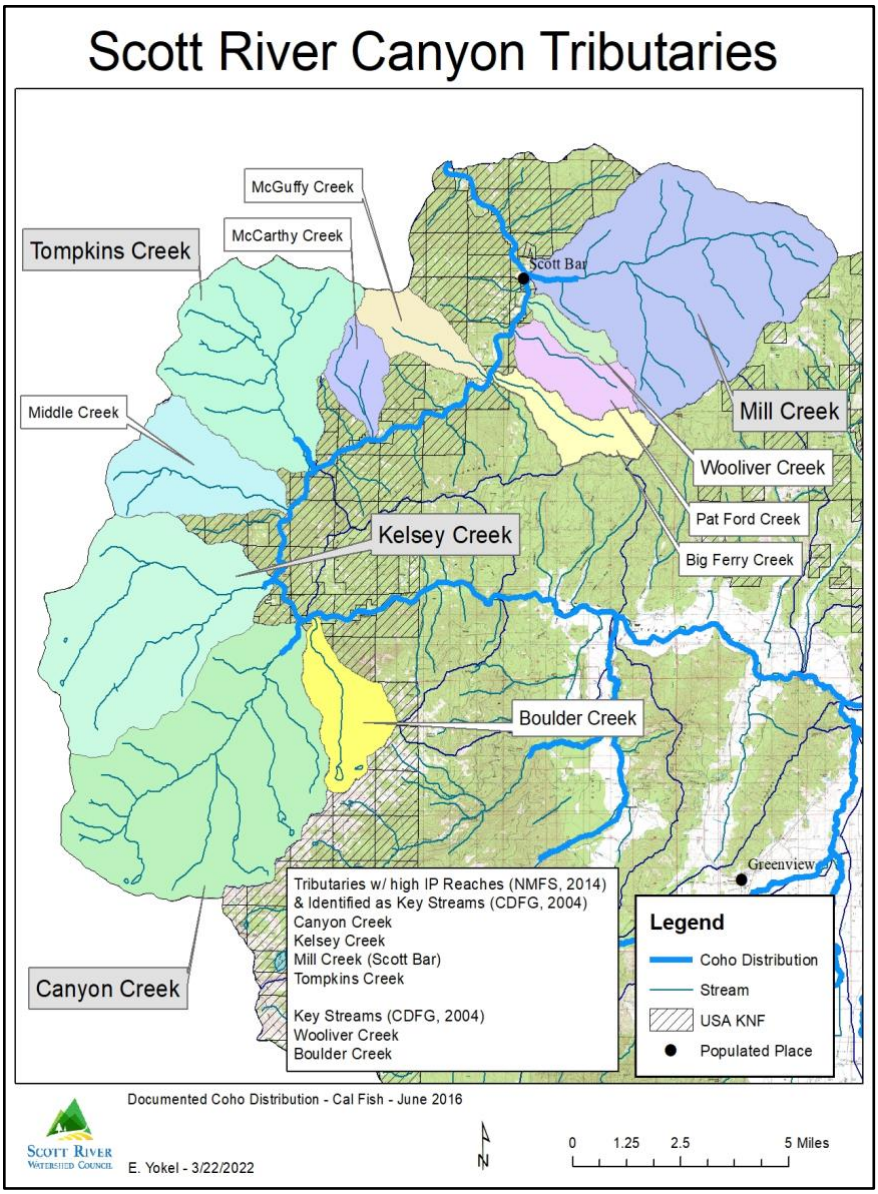
Introduction

The Mid Klamath Watershed Council (MKWC), Karuk Tribal Fisheries Program (KTFP), the Salmon River Restoration Council (SRRC), Scott River Watershed Council (SRWC) and the US Forest Service (Orleans Ranger District, Happy Camp/Oak Knoll Ranger District, and Salmon Scott River Ranger District) worked together to identify and manually treat barriers to anadromous fish passage on key tributaries in the Mid Klamath Subbasin. The Klamath River Creek Mouth Enhancement Project has been an ongoing effort to improve adult and juvenile anadromous fish passage at the mouths of tributaries to the Mid Klamath, Salmon, and Lower Scott Rivers. MKWC, KTFP, SRRC and USFS biologists have identified streams throughout the subbasin that chronically have fish passage problems at or near their confluence with the mainstem Klamath, Salmon, and Lower Scott Rivers. The Mid Klamath Subbasin Fisheries Resource Recovery Plan calls for the identification and implementation of improved fish passage and enhancement of thermal refugia sites, as well as the assessment and evaluation of long-term restoration projects.

The goals of Klamath River Creek Mouth Enhancement Project, funded by the Bureau of Reclamation, are to enhance or improve fish passage at high value cold water tributaries by manual manipulation of the rocks and substrate at the project sites. The work completed entailed creating fish step pools that lower velocity, removing, or manipulating, anthropogenic barriers, increasing pool depth, increasing flow into lower gradient channels, or concentrating flow of spread-out channel mouths. The project begins in the early spring with MKWC and contracting organization staff conducting assessments of the first 1000 feet (if viable) of each designated tributary. Assessments of these streams include identification of migration barriers, potential long-term solutions to historic problems, presence/absence surveys, and assessments of qualitative creek features. Low flow barriers to these anadromous streams and temporary dams built for fire suppression and or recreational purposes (swimmers dams) are manually manipulated to allow for adult and juvenile fish passage, where feasible.

Fish presence and absence is determined by snorkel dive surveys during these initial visits. After tributaries are assessed, field crews begin working on the most upriver tributaries and then move downstream to improve fish passage and modify any identified barriers during spring outmigration of juvenile salmonids. After work has been conducted at a tributary several monitoring visits will occur through the season. These visits entail a follow up snorkel survey of the mixing area and first 1000 feet of the creek to track movement of salmonids in or out of the system, and to conduct any follow up work that might be needed at the site. Adult and juvenile passage is taken into consideration throughout the year.

Tributaries that have high value thermal refugia areas at the creek mouths are also enhanced (if possible) throughout the season (Map 1). Thermal refugia enhancement typically entails concentrating or moving creek flow into sheltered eddies or backwater areas where cold water can concentrate and allow fish to shelter from inhospitable temperature conditions that typically occur in the mainstem Klamath River, Salmon River, and Scott River. Brush bundles are typically added to these areas to increase complex cover from predators for juvenile and adult salmonids utilizing these cold-water habitats



Map 1. Key tributaries within the lower Scott River with high intrinsic value to support juvenile Coho Salmon.

The Scott River watershed is home to three species of native salmonids: Endangered Species Act (ESA)-listed Coho Salmon (*Oncorhynchus kisutch*), Chinook Salmon (*Oncorhynchus tshawytscha*) and rainbow trout/steelhead (*Oncorhynchus mykiss*). During the summer, these fish are faced with harsh conditions as water temperatures in the mainstem Scott River frequently rise to levels that are unsuitable for rearing juveniles. Coho Salmon are particularly sensitive to high temperatures, having been shown to not persist in areas where the maximum weekly average temperature (MWAT) exceeds 16.7 °C (Welsh 2001). Temperature data from the California Department of Fish and Wildlife (CDFW) rotary screw trap site at Scott River kilometer (RKM) 7.6 shows that average daily water temperature has exceeded 20 °C for extended periods of time in each of the last three summers (Figure 1).

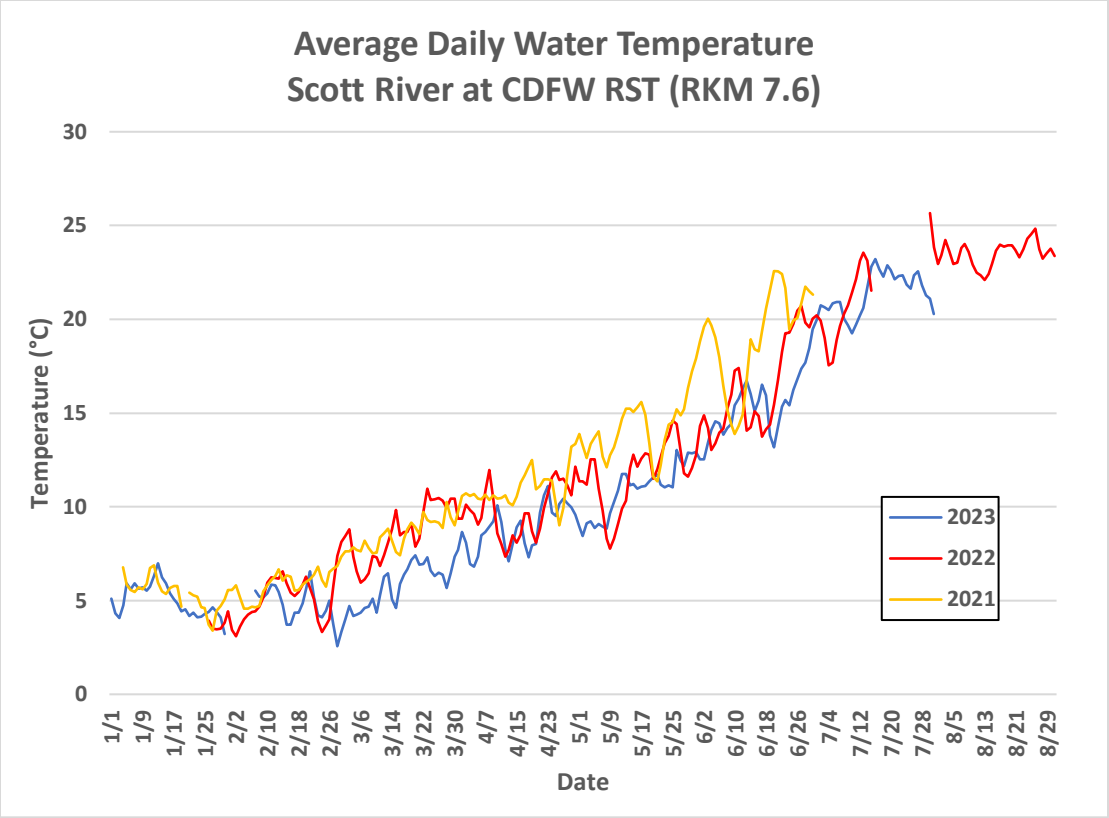


Figure 1. Average daily water temperature recorded on the Scott River at RKM 7.6. 2021-2023. Data provided by the California Department of Fish and Wildlife.

Fish Passage Improvements

Canyon Creek and Kelsey Creek are two important tributaries to the lower Scott River, providing perennial cold-water habitat. Salmonids can find refuge in both the creeks themselves and the "mixing zones": the area where the water from the creek enters the Scott River and mixes with the water in the mainstem. During the summer of 2023, SRWC, in collaboration with the MKWC, conducted work on these creeks to enhance the size and quality of these habitats. The goals of this effort included treating the creek mouths to facilitate upstream passage from the mainstem Scott River, maximizing the beneficial impact of cold water entering the Scott from the creeks, and adding cover features to refugial areas to provide juvenile salmonids with shelter from predators.

Methods

At both Canyon Creek and Kelsey Creek, a pre-treatment assessment was conducted to record baseline conditions and identify focal work areas. Staff deployed three HOBO water temperature loggers at each site: one in the creek itself, one in the mixing zone and one in the mainstem Scott River upstream of the creek mouth. Staff identified potential barriers to fish passage at the creek mouths and in the creeks upstream from the mouths. Measurements of jump heights and pool depths were taken. The area of cold-water refuge provided by the mixing zones were measured and recorded. Sections of refuge habitat that could be enhanced by the addition of cover features were identified. Direct observation snorkel surveys were performed in the mixing zone and all pool

habitats in the first 400 feet of each creek. Staff identified salmonids to species and made estimates of abundance during these surveys.

Following the establishment of these baselines, staff began conducting habitat enhancement work. At potential passage barriers, rocks were rearranged to lessen jump heights, alter prohibitive velocities, and provide deeper step pools to allow for larger jumps to be made. Measurements of jump heights and pool depths were taken after treatment. Willow branches were cut and combined into large bundles, which were then placed in refuge areas to provide cover for juvenile fish.

Staff returned to the sites after several weeks and conducted post-treatment direct observation surveys to determine if the abundance and/or diversity of salmonids in the work areas had changed.

Canyon Creek

Temperature

On August 2, 2023 SRWC staff conducted a pre-treatment assessment of Canyon Creek and its mixing zone. HOBO temperature loggers were installed in the mainstem Scott River upstream of Canyon Creek, in the mixing zone, and in Canyon Creek approximately 100 feet upstream of the mouth (Map 2).

Map 2. Map of temperature logger locations around the Canyon Creek work area. The main channel of Canyon Creek is highlighted in blue.

The data from the three temperature loggers deployed in the Canyon Creek area identified three distinct temperature signals at the three habitat units. As the summer progressed, the gap between water temperatures in the mainstem Scott and water temperatures in the Canyon Creek mixing zone shrunk. This narrowing corresponded to increasing discharge in the Scott River. On October 2nd, the daily average water temperature for all three units was between 13.4 and 13.6 °C (Figure 2).

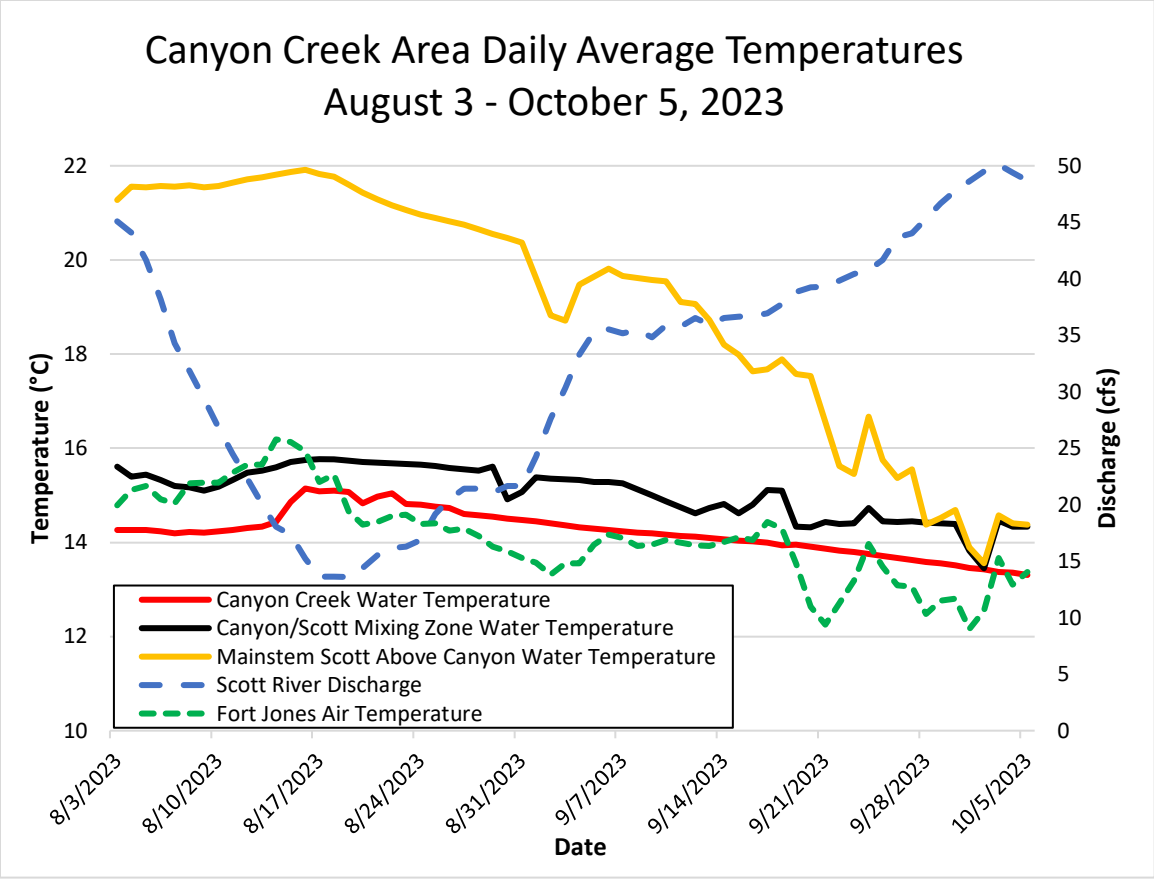


Figure 2. Daily average temperature data from the three HOBO loggers deployed in the Canyon Creek area, CIMIS station 225 and Scott River discharge data from USGS station 11519500. August 3 – October 5, 2023.

Fish Passage

Photos 1 & 2. The mouth of Canyon Creek before (left) and after (right) treatment. August 2, 2023.

Staff conducted work at two barriers near the mouth of Canyon Creek to facilitate upstream passage by salmonids. Using rocks from the stream, a series of step pools were created below barriers and concentrated flow paths were dispersed to reduce resistance. Prior to treatment, the maximum jump height (distance from water surface below barrier to water surface above barrier) at the main barrier was 1.7 feet. The maximum depth in the pool immediately downstream of the barrier was 0.75 feet. Following treatment, the maximum jump height was 1.0 feet, and the maximum pool depth was 1.2 feet. Staff snorkeled the mixing zone and the first 400 feet of Canyon Creek, identifying and counting all salmonids observed. During the post-treatment survey, greater numbers of Coho Salmon and *O. mykiss* were observed than during the pre-treatment survey (Photo 3). However, fewer Chinook Salmon were observed during the post-treatment survey (Table 1).

Canyon Creek		
Number of Barriers Treated	2	
	Pre-treatment	Post-Treatment
Date	8/2/2023	10/6/2023
Max Jump Height (ft)	1.7	1.0
Max Pool Depth (ft)	0.75	1.2
Coho Salmon Count	98	113
Chinook Salmon Count	30	3
O. mykiss Count	235	310

Table 1. Canyon Creek barrier data and fish counts, pre- and post-treatment.

Photo 3. Juvenile Coho Salmon in Canyon Creek. July 31, 2023.

Refugial Area Enhancement

Staff created "brush bundles" by cutting willow branches and tying them together with twine. These bundles were then placed in refugial areas near the mouth of Canyon Creek to provide juvenile salmonids cover, in which they can hide from predators. In total, eight brush bundles were placed in the Canyon Creek area, adding 160 ft^2 of habitat. During the post-treatment assessment on October 6th, juvenile salmonids were observed utilizing the new habitat created by the brush bundles (Picture 4-5).

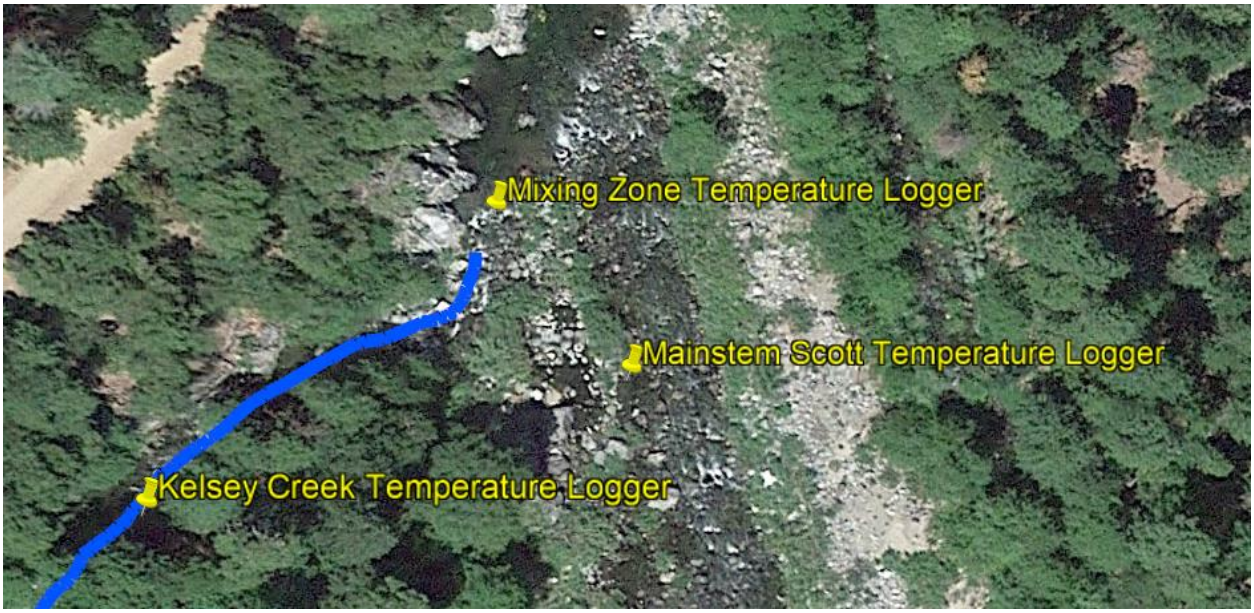
Photo 4. View of brush bundles added to Canyon Creek mixing zone. August 2, 2023.

Photo 5. Juvenile Coho Salmon among willow branches added to Canyon Creek mixing zone. October 6, 2023.

Kelsey Creek

Temperature

On August 3, 2023, SRWC staff conducted a pre-treatment assessment of Kelsey Creek and its mixing zone. HOBO temperature loggers were installed in the mainstem Scott River upstream of Kelsey Creek, in the mixing zone, and in Kelsey Creek approximately 100 feet upstream of the mouth (Map 3).



Map 3. Map of temperature logger locations around the Kelsey Creek work area. The main channel of Kelsey Creek is highlighted in blue.

The data from the three temperature loggers deployed in the Kelsey Creek area identified three distinct temperature signals at the three habitat units. As with Canyon Creek, the gap between daily average water temperatures in the mainstem Scott and the mixing zone was greatest in August and shrunk as the season progressed. On September 26th, the daily average water temperature in the Kelsey/Scott mixing zone was lower than in Kelsey Creek (Figure 3).

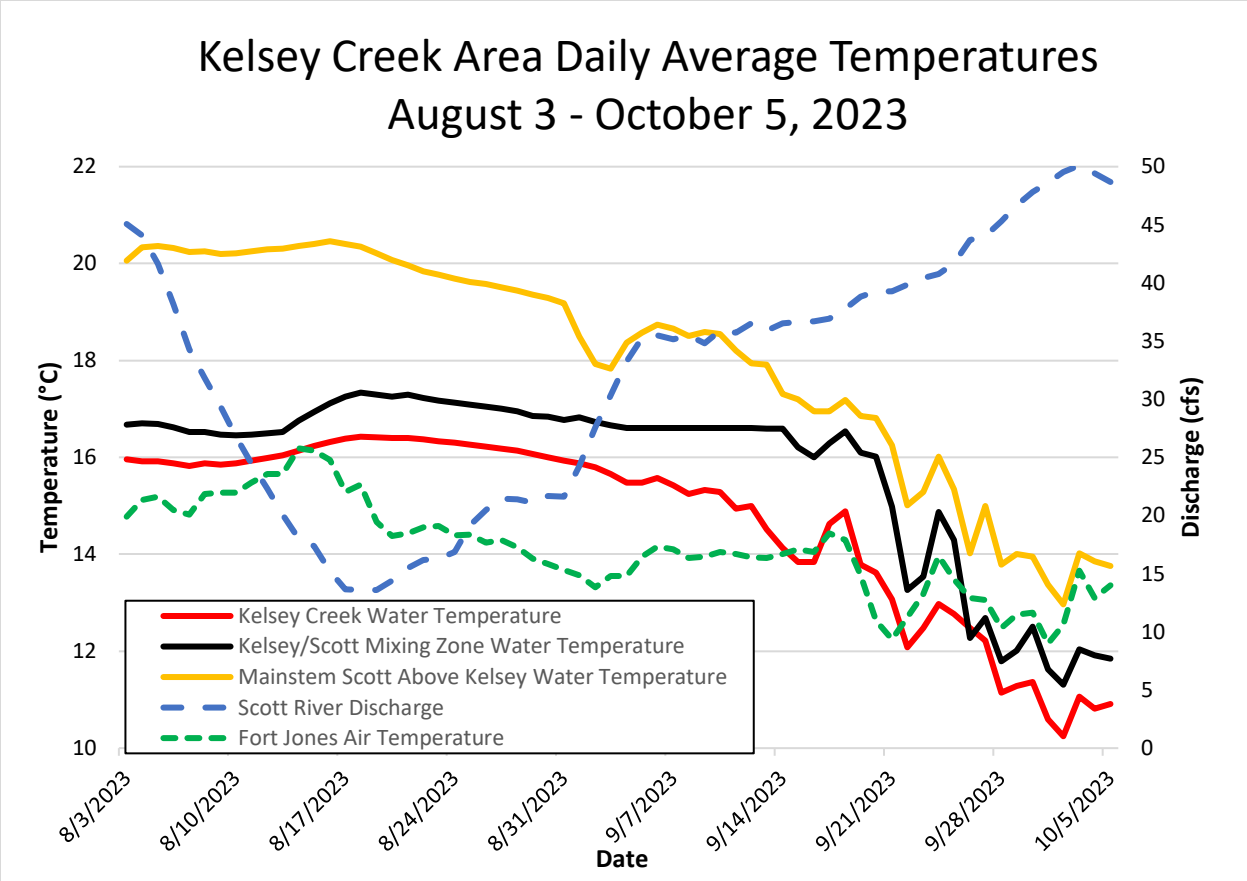


Figure 3. Daily average temperature data from the three HOBO loggers deployed in the Kelsey Creek area, CIMIS station 225 and Scott River discharge data from USGS station 11519500. August 3 – October 5, 2023.

Fish Passage

Photos 6 & 7. The mouth of Kelsey Creek before (left) and after (right) treatment. August 3, 2023.

Staff conducted work at four barriers near the mouth of Kelsey Creek to facilitate upstream passage by salmonids. Like at Canyon Creek, rocks were rearranged to create step pools and decrease velocities at crucial areas. Prior to treatment, the maximum jump height at the main barrier was 2.0 feet. The maximum depth in the pool immediately downstream of the barrier was 0.5 feet. Following treatment, the maximum jump height was 1.3 feet and the maximum pool depth was 0.8 feet (Photos 6 & 7). Staff snorkeled the mixing zone and the first 400 feet of Kelsey Creek, identifying and counting all salmonids observed. On both survey dates, Chinook and Coho Salmon were only observed in the mixing zone. Similar numbers of these species were observed at each survey event. Fewer *O. mykiss* were observed during the post-treatment assessment than during the pre-treatment assessment (Table 2).

Kelsey Creek		
Number of Barriers Treated	4	
	Pre-treatment	Post-Treatment
Date	8/3/2023	10/6/2023
Max Jump Height (ft)	2.0	1.3
Max Pool Depth (ft)	0.5	0.8
Coho Salmon Count	20 (mixing zone only)	20 (mixing zone only)
Chinook Salmon Count	3 (mixing zone only)	5 (mixing zone only)
O. mykiss Count	362	260

Table 2. Kelsey Creek barrier data and fish counts, pre- and post-treatment.

Refugial Area Enhancement

Eight brush bundles were placed in the Kelsey Creek mixing zone, adding 240 ft^2 of cover to the rearing area. During the post-treatment assessment on October 6th, juvenile salmonids were observed utilizing the new habitat created by the brush bundles (Photos 8 & 9).

Photo 8. Brush bundles added to the Kelsey/Scott mixing zone. August 3, 2023.

Photo 9. Juvenile rainbow trout/steelhead utilizing brush bundle habitat in the Kelsey/Scott mixing zone. October 6, 2023.

Discussion

It is unclear whether the work conducted at the mouths of Canyon Creek and Kelsey Creek impacted the abundance of juvenile salmonids in the project areas. While more Coho Salmon were observed in Canyon Creek following treatment, it must be noted that identifying all individuals during a direct observation survey can be extremely difficult. The difference in counts from the two observation events is not so great that it could not be explained by variation in estimates, fish using cover elements, etc. A tagging study allowing for individual fish to be recognized at multiple events could shed more light on this. The efficacy of the brush bundle additions, however, was clear. At both sites, juvenile salmonids were observed taking shelter amongst the willow branches added to the refugial areas. As these structures are simple to assemble and provide immediate benefit, they should be considered at other rearing sites lacking cover elements.

Citations

California Department of Fish and Game. 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission.

National Marine Fisheries Service. 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (Oncorhynchus kisutch). National Marine Fisheries Service. Arcata, CA.

Welsh, H.H., Jr., Hodgson, G.R., Harvey, B.C. and Roche, M.F. (2001), Distribution of Juvenile Coho Salmon in Relation to Water Temperatures in Tributaries of the Mattole River, California. North American Journal of Fisheries Management, 21: 464-470. https://doi.org/10.1577/1548-8675(2001)021<0464:DOJCSI>2.0.CO;2