TRINITY RIVER RESTORATION PROGRAM
CHANNEL REHABILITATION MONITORING PROPOSAL SUMMARY

Monitoring Proposal Title:

Ecohydrology and biologic productivity of constructed alluvial bars in the Trinity River

Proposal Submitted by:

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Restoration Goal:

Briefly state goal of Channel Rehabilitation Project element(s) that is(are) to be monitored

Examine the ecohydrology and biologic productivity of alluvial bars constructed by gravel injection and placed gravel at different planform locations within the restoration reach.

Monitoring Question:

Explicitly state monitoring objective into testable question or hypothesis

The study goal is to determine which mode of construction and location of bar placement most improves hydrologic functioning and habitat quality for salmonid fry use, growth, and survival. Hypotheses are that bars constructed with gravel injection will exhibit higher hyporheic flow rates, lower water temperatures, and larger areas of thermal refuge for fish, which reside longer in proximity to the bar and survive at higher rates to migrate downstream later and at a relatively larger size. Hyporheic discharge should be higher in gravel injection bars because fluvial sorting and alignment of grains increase hydraulic conductivity over that in poorly sorted, packed grains that assumedly compose placed bars. Enhanced hyporheic discharge will form larger areas of relatively cool water for fry rearing. Growth rates of fish that reside near injection bars will then be higher relative to areas that are outside the influence of the bar because flow temperatures associated with the bar will promote a greater food base in terms of biofilm coverage and macroinvertebrate diversity and density.

Monitoring Design Plan:

Describe or summarize proposed monitoring plan in one page or less. Identify the channel rehabilitation project properties that are to be measured and proposed methods. Identify how monitoring addresses Monitoring Question. Attach additional information to the proposal summary if desired.

The ecohydrology of bars will be measured as hyporheic discharge, distributions of water temperature proximal to bars, and juvenile fish rearing depths and velocities. Hyporheic discharge will be quantified with Darcy's Law using piezometers to measure hydraulic gradient and bulk grain-size distributions to estimate hydraulic conductivity and bed porosity. Due to uncertainty in grain size relationships to porosity and hydraulic conductivity, calculations of hyporheic flow speeds may be replaced with intergravel flow velocities measured with non-toxic dye injected in the up-gradient side of bars in the study. Temperature isoclines proximal to the bar will be derived from water temperatures measured with temperature monitors installed at variable distances along and away from the water edge. Juvenile fish rearing depths and velocities will be measured by methods in Martin et al. (2013) at flow rates set by the record of decision (USDOI, 2000) during the fry rearing time of year (February through June). Salmonid fry use

and growth rates in the vicinity of study bars will be measured with snorkel surveys and seining and/or minnow trapping fish for tagging (clip or dye) and recapture.

Monitoring Locations and Number of Sites:

Identify Projects and locations within Projects to be sampled

Study bar types will include point bars with and without side channels, mid-channel bars, lateral bars, and lag bars that form in the lee of roughness elements. Planform locations for study will include straight reaches (sinuosity <1.2), free meandering sections (sinuosity ≥1.5), and forced meanders (by bedrock, large wood, or other immobile features). Bars chosen for study will exhibit a range of hydraulic gradients in the cross channel or longitudinal directions and proximities to hydraulic controls. Study bars will be located throughout the restoration reach so that downstream increases in water temperature are considered when evaluating the ecohydrology and biologic function of constructed alluvial bars.

Monitoring Frequency:

Identify when sampling will be performed, frequency (e.g., one-time, annually for five years)

Weekly to continuously, depending on the metric, January through June for three different water year classifications.

Study motivation:

In the suite of restoration work undertaken by the Trinity River Restoration Program (TRRP) between Lewiston Dam and the North Fork Trinity River, California (hereafter restoration reach) is construction of alluvial bars by gravel injection and placed gravel. The proposed study would examine the ecohydrology and biologic productivity of these bar types at different planform locations within the restoration reach. The study goal is to determine which mode of construction and location of bar placement most improves hydrologic functioning and habitat quality for salmonid fry use, survival, and growth. This information will inform restoration work that seeks to promote channel conditions that increase adult salmon populations, which is the fundamental objective of the TRRP.

Ock et al. (2015) studied two injection bars and two placed bars in the Lowden Ranch area and found that organic particulate matter (OPM) was more efficiently processed in the former and that mid-channel bars surpassed point bars in this process. Ock et al. (2015) also found that water temperatures proximal to mid-channel injection bars were notably cooler than near point bars, but neither finding was related to juvenile fish production. Additionally, Martin et al. (2013) and Alvarez et al. (2013) have enumerated pre- to post-restoration changes in rearing habitat for juvenile Chinook and coho salmon, but associations between habitat availability and salmonid fry residency and growth rates were not made. The question therefore remains as to which type of constructed bar most increases fish production in the Trinity River.