TRINITY RIVER RESTORATION PROGRAM
CHANNEL REHABILITATION MONITORING PROPOSAL SUMMARY

Monitoring Proposal Title:

Spawning site selection by salmon and reciprocal feedbacks between spawning activity and delivery of marine nutrients by salmon on 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

Annual redd surveys on the Trinity River between Lewiston Dam and the North Fork Trinity River, California (hereafter restoration reach) indicate that areas where Chinook spawning occurs in high densities are consistent year to year (Chamberlain et al., 2012). This is particularly surprising given that one of the "hotspots" for spawning, Sheridan Reach near Junction City, is a run habitat type, which are generally avoided by spawning salmonids (Montgomery et al., 1999). Overall, factors driving spawning site selection by wild Chinook on the Trinity River are unclear. Addressing this knowledge gap is important for designing channel restoration projects to increase spawning habitat and bolster salmonid production in the Trinity River, which is the primary objective of the Trinity River restoration program (TRRP).

Monitoring Question:

Explicitly state monitoring objective into testable question or hypothesis

Several hypotheses have been used to explain spawning site selection by salmonids in the Trinity River. May et al. (2009) hypothesized that Fall Chinook salmon in the Sheridan Reach spawn near channel margins and other areas with low Shields stress relative to values in the thalweg to protect their eggs from damage from bed scour. Competing hypotheses are that 1) redds are constructed near channel margins because juvenile fry habitat is in closer proximity than if redds were constructed in the middle of the channel; 2) spawnable substrate may be more available on channel margins due to lower shear stress promoting deposition of finer gravel in these areas; 3a) spawners seek cooler water and 3b) cover from riparian vegetation near channel margins; 4) mass spawning occurs where groundwater upwelling results from regional influences (bedrock outcrops, tributary inflow, et al.); and 5a) consistently high numbers of spawners condition the bed for subsequent generations of salmon and 5b) provide marine-derived nutrients (MDN) that increase the prey food base and amount and quality of rearing habitat for juvenile salmonids.

We propose to systemically test hypothesis 1-4 at locations throughout the restoration reach where high-density spawning annually occurs on whole bars features or spot locations along channel margins. Study results will enable identification of metrics for locating channel areas where spawning habitat is optimal, may be improved by mechanical rehabilitation, or is unlikely to be improved by channel modifications or gravel supplementation due to lack of regional influences on spawning habitat quality selection, such as bedrock-forced areas of upwelling groundwater.

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.

Data to assess hypothesis 1-4 include correlation analysis of the proximity of juvenile rearing habitat to redds (hypothesis 1); Wolman (1954) pebble counts and McNeil core samples in known spawning areas and adjacent areas of the channel that exhibit comparable Shields stress during spawning and incubation times of year (hypothesis 2); installation of temperature monitors in sediment sampling areas and measurements of shaded area near stream banks (hypothesis 3); piezometer monitoring to identify mass spawning areas with upwelling groundwater and possibly geophysical measurements to locate subsurface bedrock forcing hyporheic flow upward through substrate in the channel (hypothesis 4).

Monitoring Locations and Number of Sites:

Identify Projects and locations within Projects to be sampled

Up to a dozen locations throughout the restoration reach where high-density spawning annually occurs on whole bars features or spot locations along channel margins.

Monitoring Frequency:

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

One time to continuously, depending on the metric, September through January for three different water year classifications and/or years with variable numbers of spawning populations.

Additional information:

Addressing hypothesis 2-4 will refine hypothesis 5 for determining how salmon may be the architect of their own rejuvenation by investigating how spawning effects the structure and stability of stream beds and creates and maintains fish habitat in streams. This approach to salmon restoration recognizes physical processes that create and maintain fish habitats are linked to the disturbance spawning salmon impart to streams (Gottesfeld et al., 2004; Hassan et al., 2008). In addition, MDN delivered to streams by salmon bolster riparian vegetation growth, which increases wood delivery to the channel and increases hydraulic complexity and the amount and quality of rearing habitat for juvenile salmonids (Helfield and Naiman, 2001). MDNs also increase the prey food base for juvenile salmonids by producing an upward trophic cascade that starts with catalyzing biofilm growth and ends with higher growth rates for juvenile salmon (Wipfli et al., 2003, 2009). I recognize that managing salmon returns is outside the TRRPs objectives, but the program is well-positioned to identify threshold numbers of spawners that may be required to enhance stream conditions for salmon reproduction. Fisheries managers can then use this information to manage salmon returns to provide levels of spawning disturbance and MDN that will help TRRP meet its restoration goals of producing large returns of wild salmonids.