Demonstration Project to Test a New Interdisciplinary Approach to Rehabilitating Salmon Spawning Habitat in the Central Valley

Summer 2005

This was the twelfth quarter of this CALFED project to demonstrate the utility of the Spawning Habitat Integrated Design Approach (SHIRA). In the previous quarter activity focused on data analysis and manuscript writing. There was also some preliminary planning performed for the summer 2005 pilot project, but that was limited due to higher than normal flows on the river. This quarter saw the pre-project characterization, design development, final design selection, and construction of the 2005 pilot project. As previously described, the 2005 plan was to continue to use SHIRA's slope creation methodology to continue to rehabilitate the Mokelumne River's longitudinal profile for another ~500' of channel length using ~3000-4000 tons of gravel. For the 2005 pilot experiment, the key scientific question was to assess the hydrodynamic outcome and salmon-spawning utilization after filling in a deep gravel-mining hole in the channel as part of the on-going longitudinal profile rehabilitation framework. The selected site was the mining hole located immediately downstream of the 2004 gravel-placement location.

The pre project site characterization of the 2005 experimental site involved limited new data collection, because the site was fully characterized in fall of 2004, and little change was evident in a preliminary assessment. Some supplemental high-resolution bathymetric surveying of the deep hole as well as the mouth of Murphy Creek was done with EBMUD using boat-based echo-sounding. Previous data was already sufficient for the necessary stage-discharge relation, velocity and depth verification data gathering, eddy viscosity parameterization, bed roughness parameterization, spawning habitat characterization, adult holding habitat characterization, and sediment budgeting based on historic data for the site. Using all of this data, an updated digital elevation model (DEM) was programmed for the entire rehabilitated zone from the fish fence below the dam down to 1994 rehabilitation riffle just downstream of the mouth of Murphy Creek. Using that DEM, a new 2D model simulation was obtained to characterize the baseline hydrodynamic, sediment transport, and spawning habitat-quality regimes for this reach.

Design scenario development and testing was focused primarily on using augmented gravel to fill the mining hole and create appropriate pool, riffle, and bar units. A total of 10 alternative project-site configurations were evaluated to determine what geomorphic and ecologic benefits could be attained from different design concepts. In the end, all design scenarios were tested against several management issues. The primary concerns were filling in the hole, re-balancing velocities to obtain good spawning habitat while also avoiding significant erosion during spawning, and providing some pool habitat. Beyond these geomorphic considerations related to slope and riffle-pool geometry, designs were evaluated for their relative gain in spawning habitat compared to the pre-project condition as well as their availability of adult holding habitat. Juvenile habitat is not limiting in this system. In the end, the final design that was selected in consultation with EBMUD and CDFG involved an additional experiment at the hydraulic-unit spatial scale in which the site was designed to have 6 different combinations of depth, velocity, and substrate size to see if spawners showed any particular preference at a higher resolution than the predicted using the 2d model's global habitat suitability index method. These 6 hdyraulic-units were nested in an appropriate alternate bar geomorphic-unit configuration.

In September UC Davis and EMBUD worked together to construct the project according to our experimental design plan. This time we tested a new construction method in which we used a 20'x20' "stake-out" grid to monitor the progress of the front-loader and insure its placement accuracy. Grid points ended up being properly built within ~0.5', with the primary limitation being microtopography caused by the tire tracks of the heavy front-loader. As for the last 2 years, available boulders were placed as additional habitat features in locations and positions according to lessons learned from the 2001-2004 SHIRA experiments. Also, for the second time, pea gravel suitable for steelhead spawning was made available for use in the project, so that was placed in a single patch to yield a significant increase in habitat quality for that species. Finally, a single tree trunk was placed in the channel for habitat heterogeneity. One problem during construction was that the gravel supplier deviated form the contractual terms and provided generally coarser sediment than desired.

Long-term monitoring, evaluation, and adaptive management is underway in autumn 2005, including biological monitoring for site utilization by spawners.

Two previously reported manuscripts were accepted for publication in peer-review scientific journals, bringing the total from this CALFED project to 8. The references for these are

Pasternack, G. B., Gilbert, A. T., Wheaton, J. M., Buckland, E. M. in press. Error Propagation for Velocity and Shear Stress Prediction Using 2D Models For Environmental Management. Journal of Hydrology.

Merz, J. E., Pasternack, G. B., Wheaton, J. M. in press. Sediment Budget for Salmonid Spawning Habitat Rehabilitation in the Mokelumne River. Geomorphology.