Investigating Large Woody Materials to Aid River Rehabilitation in a Regulated California River

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To aid in management and rehabilitation of regulated rivers in the Mediterranean climate of California, it is necessary to understand in-channel large wood processes at the habitat unit, reach, and watershed scales. Field work conducted at each scale has helped to develop a conceptual model of wood dynamics for use in decision-making processes.

Few river rehabilitation projects have used large woody materials (LWM) as a tool for improving salmonid habitat, and there is little science to guide the enhancement or placement of LWM. This research is investigating the role of LWM in the Mediterranean climate zone of California, in order to develop a scientific conceptual model of LWM dynamics for regulated rivers in the region and a decision-making framework that will enable river managers to include scientifically based LWM structures into rehabilitation designs, thereby enhancing stream complexity and habitat diversity, and creating robust ecosystem health.

(1) To obtain insight into LWM dynamics in regulated rivers, data on large wood (>1 m length, >10 cm diameter) attributes, including wood piece length, diameter, and decay condition, were collected from the 7.6 km reach between Camanche Dam fish fence and Mackville Road Bridge on the Mokelumne River, CA between September 2006 and March 2007. Hydraulic habitat units were identified and mapped based on velocity and depth measurements. The first kilometer of the reach was surveyed for riparian corridor recruitment potential. Fall-run Chinook salmon redd locations were recorded by East Bay Municipal Utilities District (EMBUD) biologists. A GIS database of all LWM hydraulic structures, geomorphic channel characteristics, and redd locations for the 2006-2007 field season has been produced using ESRI's Arc9.

(2) In order to create hydraulic complexity, a logjam of 30 logs with length > 5 m and diameter > 30 cm was built on the Mokelumne River, 500 m downstream of Camanche Dam fish fence in September 2007, in conjunction with EBMUD biologists. Materials used to build the logjam were obtained from the local riparian corridor; a number of dead alders along the channel and a few living oak branches hanging over an adjacent trail were cut down for use in the project. Existing wood structures present in the channel and on the bank at water's edge were used as linchpins for the jam. Imported boulders and gravel were used as ballast; no cables or other non-natural tie-downs were used. This logjam will be monitored for signs of individual wood piece movement as flows vary, and for its use by various salmonid and other aquatic species life stages.

LWM measurements on the lower Mokelumne River.

(3) To develop a model of LWM dynamics above reservoirs, fieldwork in summer 2006 was conducted in Pardee Reservoir on the Mokelumne River, Bullard's Bar on the Yuba, Oroville on the Feather, Folsom on the American, and Don Pedro on the Tuolumne. Quantification of LWM that originated in the upper watershed and traveled into the reservoirs during high precipitation and snow-melt events in water year 2005-2006, was done using a helium filled blimp with attached camera to obtain aerial photographs. We aim to develop a conceptual model of wood flux into reservoirs based on wood recruitment potential, flow rates into reservoirs, and significant upper watershed precipitation events (rainfall intensity, duration, and frequency) events.

Key findings: (1) Using the non-parametric Kolmogorov-Smirnov test, there were no significant differences in LWM presence across all habitats (riffle, run, glide, pool) in the 7.5 km reach directly below Camanche Dam on the Mokelumne River, thus LWM density distribution was statistically indistinguishable throughout the study reach. There were significant differences in redd density between riffles and all other habitats, but no significant difference in redd density between runs and glides. Pools were not tested since no redds were recorded in pools. These results suggest that salmon preferentially use riffle habitat to build redds, while runs and glides are used secondarily. Using the non-parametric Wilcoxon rank sums test, wood densities were significantly different than redd densities in riffles and runs, but not significantly different in glides. These findings suggest that LWM is important to salmonid redd locations in marginal hydraulic habitat zones such as glides, where lower velocities may preclude these areas from use for redd building without LWM presence to create hydraulic variability. (2) It is feasible to build logjams using local riparian corridor trees. Existing structural elements play an important role by serving as linchpins for building the jam. (3) Wood accumulations in reservoirs are subject to watershed scale processes that should be predictable based on a few variables: watershed hydrograph, forest condition, and years since last large runoff year.

We expect to use the final year of this grant to develop a PhD proposal to identify causal natural and anthropogenic factors in LWM supply and fate at the basin scale.

Professional Presentations

Senter, Anne E. and G.B. Pasternack, Investigating the Geomorphic and Ecologic Functions of Wood in Relationship to Habitat Type and Salmonid Redds on a Regulated California River, San Francisco, CA, American Geophysical Union, Dec. 2006

Collaborative Efforts

PI Greg Pasternack has collaborated with EBMUD extensively since 1999 on rehabilitation projects on the Mokelumne River below Camanche Dam. The LWM project funded by this grant was also funded in part by an EBMUD-affiliated grant. Dr. Joseph Merz, an EBMUD fisheries biologist extensively involved in the rehabilitation projects, has agreed to be a Master's committee member for Anne Senter.

Professor Herve' Piegay, a visiting scholar with expertise in physical wood processes from the Center for National Research (CNRS-UMR) in France, accompanied the researchers into the upper Mokelumne River watershed in July 2007 to discuss research approaches to wood flux across the Sierra, wood recruitment potential in individual watersheds, physical processes associated with wood movement and variable flows, and identification methods to determine transport distance and physical breakdown patterns.

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