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H11C-0850 0830h POSTER Interactions Between Sediment Storage and Bed Material Transport: A Field and Flume Study

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Significant channel aggradation events have occurred in numerous coastal northern California watersheds over the past 50 years, leaving lasting impacts on stream channel morphology and habitats. Our study focuses on sediment movement and channel morphology following large aggradation events and specifically focuses on the relationship between volume of stored sediment and bed material transport rates.

Cuneo Creek, a steep gravel-bed stream in the Eel River basin, has sustained substantial channel aggradation events in 1955, 1964 and 1997. Relationships between volume of stored sediment and bed material transport were developed for the time periods between 1964-1997 and 1997-2000. Bed topography was reconstructed and volume of sediment removed was calculated for 7 time steps between 1964 and 2000. Results indicate the majority of sediment from the 1964 event was removed in the first 10 years by rapid channel incision. Surveys following the 1997 event show the majority of 1997-produced sediment was removed in 1998. In both cases, channel morphology evolved from a braided, unarmored channel with a relatively planar bed back to an armored, single-thread channel.

Experiments designed to model Cuneo Creek were conducted in a flume (length=12 m, width=0.76 m, slope=3.5%) to further examine the storage-transport relation. Transport rate at the flume outlet, water surface slope, surface topography and texture were measured throughout the experiment. The bed consisted of a sand and gravel mixture ranging from 0.2511.2 mm (median=1 mm, std dev=1.8 mm). Aggradation and degradation were induced by increasing, then decreasing the sediment feed rate, while holding discharge constant.

During an aggrade/degrade cycle, the channel evolved from a stable single-thread armored channel with alternate bars to an actively braided, unarmored system covering the entire flume width during the aggradation phase; after the feed rate was decreased, the channel returned to a single-thread channel. This progression follows closely that documented in Cuneo Creek. Significant adjustment to transport rates occurred at four positions during the aggrade/degrade cycle: (1) transport rates increased slightly after the feed rate was increased and the channel began to aggrade; (2) transport rates increased rapidly after the feed rate was decreased and the channel began to degrade; (3) peak transport was observed during degradation, just after the channel transitioned from braided to singlethread; (4) transport rates decreased as the channel stabilized and became armored.

Consistently higher transport rates during degradation suggest downstream transport efficiency is greater during channel degradation than aggradation. We also infer higher transport efficiency of a single-thread channel relative to a braided channel. These results suggest the relationship between bed material transport and storage volume is not a single function, but exhibits hysteresis and would most appropriately be modeled as separate functions for aggrade and degrade phases.