Fine Sediment Dynamics in the Upper Colorado River During Spring Runoff and Summer Baseflows: Implications for Flow Recommendations and Biological Productivity

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Abstract. Flow recommendations for the listed endangered native fish species in the Upper Colorado River are based, in part, on the hypothesis that removal of fine sediment from the gravel and cobble bed will increase primary biological productivity, and thus, the carrying capacity for the listed fish species. Studies in rivers where salmonid species spawn have shown that flushing of sands and fine gravels to appreciable depths requires mobilization of the framework gravels. The results of this investigation, conducted in the 15-Mile Reach of the Colorado River, indicate that the salmonid model of fine sediment infiltration into the framework gravels, and subsequent mobilization of the gravels to flush the fines, may not be directly transferable. In contrast to the relatively clean rivers that support salmonid spawning, the Colorado River carries a high load of fine (silt/clay-sized) sediment, derived from short-duration thunderstorm events that occur during the late summer baseflow period. Although most of the annual sediment load in the river is transported during the snowmelt runoff period, the summer storm events and resulting runoff control fine sediment (silt/clay-sized) delivery. A more appropriate paradigm may, therefore, be that fine sediment dynamics during the baseflow season are controlled by the presence or absence of a temporally variable supply of silts and clays that deposit on the bed surface in low energy zones within the channel. Detailed field studies and 2-dimensional hydrodynamic modeling have identified shear stress values for fine sediment deposition (<1.4 N m⁻²) and subsequent remobilization (>1.4 N m⁻²). Periodic mobilization of the framework gravels that comprise the bed material of the river during the snowmelt runoff also creates a disturbance regime that results in remobilization of deposited fines. However, on an annual basis, delivery of sufficient water to the reach to ensure removal of the fine sediment deposits from runs, or to provide an adequately sized area where deposition will not occur within riffles, may be the key to ensuring biological productivity during the baseflow portions of the year.

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