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Thinking Outside the Channel to Design Optimal Flow Regimes that Favor Salmon Populations and Energy Production

River flow influences salmon indirectly, through its effects on temperature, prey, refuge, and other direct influences on survival and reproduction. Recent studies suggest that slow, shallow habitat provides essential habitat for juvenile fishes, including Chinook salmon. In this study, I developed a quantile recruitment model for fall Chinook salmon that represents benefits of floodplain inundation on prey, salmon bioenergetics, survival, and recruitment. Cohorts of salmon from nests constructed in the same space-time quantile are tracked by the model until they exit the tributary. Using this simplified quantile model, I used a genetic algorithm to allocate a parametric function describing two pulse flows, where the magnitude, timing, and duration of seasonal pulse flows maximize salmon production and energy from hydropower. Multiple seeds were compared to ensure convergence among solutions beginning at different places in parameters space.

Results highlighted the importance of indirect effects of flow, mediated by temperature and access to productive floodplain habitat during late winter and early spring. The optimization recommended earlier peak flows and an alternative tactic for successful salmon production in warm climates. Peak flows tended to be steep and of shorter duration during drier hydrologic years and broader during wet years when shaped to maximize Chinook salmon production. These results will be compared with those of optimizations to maximize energy value for producers to determine the degree to which economic and salmon objectives are aligned at a seasonal scale.