SCCWRP #1069

Targeted hydrologic model calibration to improve prediction of ecologically-relevant flow metrics

Sarah R. Parker[1], Stephen K. Adams[2], Roderick W. Lammers[3], Eric D. Stein[4], Brian P. Bledsoe[3]

[1]Anderson Consulting Engineers, Inc., Fort Collins, CO
[2]Colorado State University, Fort Collins, CO
[3]University of Georgia, Athens, GA
[4]Southern California Coastal Water Research Project, Costa Mesa, CA

ABSTRACT

River flows exert dominant controls on in-stream biota. Quantifying linkages between hydrology and biology is important for assessing the effects of flow alteration on ecological functions. Hydrologic models are often used to quantify these flow-ecology relationships and guide management actions. Traditional model calibration techniques typically focus on a best overall fit criterion that may not be suitable for environmental flow applications where certain elements of the flow regime exert a dominant influence on biotic composition. We present an approach for hydrologic model calibration that improves the accuracy of calculated flow metrics known to be significant drivers of ecosystem response. First, we developed regional flow-ecology relationships based on streamflow gage and benthic macroinvertebrate data from southern California to determine which streamflow metrics best explain variability in taxonomic and trait-based biotic indices. Next, we developed and calibrated a series of hydrologic models to minimize error in these important flow metrics. For our study sites, flow flashiness and low flow frequency (indicative of drying) were found to best explain biotic condition. Hydrologic models calibrated specifically to minimize errors in these flow metrics predicted macroinvertebrate indices better than models calibrated to maximize fit to the overall flow regime. This ecological-calibration approach requires some a priori knowledge of flow-ecology relationships, but it produces results that can improve assessment of the impacts of changing flow regimes on biota and guide the development of strategies to mitigate ecological degradation.