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Establishing Environmental Flow Targets in Complex Environments

Eric D. Stein, Sarah Yarnell, Samuel Sandoval-Solis, Belize A. Lane, Julie Zimmerman, Jeanette Howard, Theodore E. Grantham, and Rob Lusardi

[1]*Southern California Coastal Water Research Project, Costa Mesa, CA*
[2]*University of California, Davis*
[3]*Utah State University*
[4]*The Nature Conservancy*
[5]*University of California, Berkeley6*
[6]*University of California, Davis/ California Trout*

Abstract

Environmental flow targets are based on relationships between hydrologic alteration and changes in biological community composition [1,2]. Given the inherent complexities of establishing these relationships they are often developed at local or watershed scales for specific species of interest. However, broad-scale implementation of environmental flow programs requires a more parsimonious approach that can be applied across landscapes with wide ranges of environmental gradients and a diversity of biological assemblages. California (USA) is a perfect laboratory for developing approaches for setting environmental flow targets in complex and diverse environments. California's geography is characterized by extreme natural gradients. California boasts both the highest and lowest elevations in the conterminous US, and its ecoregions range from temperate rainforests in the Northwest to deserts in the Southeast. California's geology is also complex, ranging from recently uplifted and poorly consolidated marine sediments in the Coast Ranges and alluvium in its broad internal valleys to granitic batholiths along the eastern border with recent volcanic lithology in the northern mountains. As a result, the State's environmental diversity is associated with a high degree of biological diversity and endemism in stream fauna [3]. This complexity in geography and ecology is matched by a diversity of flow management challenges in the state. The desire to restore and protect ecological integrity must be balanced against competing water uses including timber harvest, agriculture, hydropower and dam operation, and urban uses including recent efforts to recycle stormwater and wastewater for consumptive uses instead of discharging it to waterways. Developing environmental flow targets for a large complex region like California can serve as a template for addressing similar challenges in many other places. In this paper, we present a tiered framework for establishing statewide environmental flow targets. The first tier (discussed in this paper) includes classifying streams into relatively homogenous hydrologic classes and setting reference-based functional flow targets for each class. The second tier provides an approach for linking flow targets to appropriate biological endpoints at statewide, regional, and watershed scales.