

Tools for managing hydrologic alteration on a regional scale: Setting targets to protect stream health

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ABSTRACT

1. Widespread hydrologic alteration creates a need for tools to assess ecological impacts to streams that can be applied across large geographic scales. A regional framework for biologically based flow management can help catchment managers prioritise streams for protection, evaluate impacts of disturbance or interventions and provide a starting point for causal assessment in degraded streams. However, lack of flow data limit the ability to assess hydrologic conditions across a region.
2. Hydrologic models can address this problem. Regionally calibrated hydrologic models were used to estimate current and reference flows at 572 bioassessment sites in southern and central coastal California. Flow alteration was characterized as the difference in 39 flow metrics calculated from simulations of present-day and reference flow time-series, calculated under up to four precipitation conditions.
3. Biological condition was assessed with the California Stream Condition Index (CSCI) and its components. Logistic regressions were used to predict the likelihood of high scores (i.e. ≥ 10 th percentile of the CSCI reference calibration data). Statistically significant relationships between increasing severity of hydrologic alteration and decreasing biological condition were used to set thresholds that reflected tolerance for risk of a stakeholder advisory group.
4. An index of hydrologic alteration was created by selecting flow metrics based on their importance for predicting biological response variables in boosted regression tree models. Metrics were selected in the order of decreasing importance, and no more than two metrics per metric class were selected (i.e. duration, frequency, magnitude, timing and variability). Seven metrics were selected: HighDur (duration of high-flow events), HighNum (# of high-flow events), NoDisturb (duration between high- or low-flow events), MaxMonthQ (maximum monthly discharge), Q99 (99th percentile of daily streamflow), QmaxIDR (interdecile range of annual maxima) and RBI (Richards–Baker Index).
5. Applying the index to data from a probabilistic survey, 34% of stream-miles in southern California were estimated to be hydrologically altered. One of four management priorities were assigned to each site based on biological condition and hydrologic status: protection (healthy and unaltered, 52% of stream-miles, monitoring (healthy but altered 4%), evaluation of flow

management (unhealthy and altered, 30%) and evaluation of other management (unhealthy but unaltered, 14%).

6. Regionally derived biologically based targets for flow alteration allow catchment managers to prioritise activities and conduct screenings for causal assessments across large spatial scales. Furthermore, regional tools pave the way for incorporation of hydrologic management in policies and catchment planning designed to support biological integrity in streams. Development of regional tools should be a priority where hydrologic alteration is pervasive or expected to increase in response to climate change or urbanisation.

Full Text

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