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Selecting comparator sites for ecological causal assessment based on expected biological similarity

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ABSTRACT

Streams and other waterbodies in poor ecological condition often require causal assessment to determine appropriate follow-up actions. However, site-specific causal assessments can be time consuming. To streamline the process, we describe a quantitative method that expedites a key component of causal assessment: identifying a group of ecologically similar (comparator) sites with which to compare and contrast biological condition and stressor exposure at the site of interest. A good set of comparator sites should: 1) represent environments that could support biota similar to the degraded site in the absence of disturbance, 2) comprise a gradient of biotic conditions, and 3) contain enough sites to assess variability. We used expected biological similarity to select good sets of comparator sites from a large pool of potential sites for 15 poor-condition test sites in Southern California. Expected biological similarity was measured as Bray–Curtis dissimilarity values (BC) calculated from the expected benthic macroinvertebrate taxa lists produced by a predictive biotic index of stream health. We used an expected BC threshold of _0.05 to create the sets of comparator sites. Based on this criterion, we identified >70 comparator sites for each of the 15 test sites. To illustrate their utility in a causal assessment, we used the comparator sites to derive evidence of whether 4 example stressors—elevated conductivity, elevated N, elevated fine sediment, and hardening of the stream channel—contributed to the poor biotic conditions at each of the 15 test sites. We used spatial-temporal co-occurrence type of evidence to evaluate the data and found that elevated conductivity and elevated fine sediment were the likely cause of biotic degradation at the most test sites. We developed the comparator site selection approach described here in the context of the stream bioassessment program in California, USA, but this approach could be adapted by any bioassessment program with a large amount of sample data and an associated predictive index of biotic condition, such as the National Aquatic Resource Survey. Furthermore, this approach lays the groundwork for rapid, screening-level causal assessment to become part of routine bioassessment, which would then inform follow-up management actions.