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Estimating the spatial representativeness of bioassessment samples in stream networks

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Abstract

Stream management and regulatory decisions are typically applied to large reaches (several km) or whole watersheds, but assessment of stream condition is typically based on discrete 150-m sampling reaches that are sparsely distributed across a watershed. Therefore, there is a need to extrapolate measured variables, such as bioassessment scores, to unmeasured reaches, and to understand uncertainty inherent to extrapolations. Spatial statistical network (SSNs) models allow estimation of bioassessment index scores at unsampled locations based on their proximity to sampled locations within a stream network. We developed SSNs for 6 watersheds in northern and southern California to explore their utility in extrapolating scores for a bioassessment index, the California Stream Condition Index (CSCI). SSN models are able to extrapolate estimates of condition from observed locations to unsampled reaches in a spatially explicit manner, while providing estimates of confidence in these extrapolations. Although these models did not ultimately support general guidance on the length of stream represented by a single sample, they can create maps that support numerous management decisions, such as a) delineating regions where scores meet or fail objectives; b) extrapolating estimates to upstream tributaries or downstream reaches; and c) identifying areas where more sampling is needed to improve confidence. Maps can easily be redrawn to incorporate new data as they become available. Future efforts should explore the ability create regional maps of similar watersheds to reduce effort and increase confidence in extrapolated scores. Models can and should be developed for other management endpoints, such as algal indices of biotic integrity, hydromodification, and riparian wetland condition.