

Spatial statistical network models to estimate the spatial representativeness of bioassessment samples

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EXECUTIVE REPORT

- Stream management and regulatory decisions are typically applied to large reaches or whole watersheds. However, assessment of stream condition relative to management or regulatory targets is based on discrete 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. They facilitate the search for patterns at large spatial scales appropriate for biological indicators.
- We developed SSNs for 6 watersheds in northern and southern California to explore their utility in extrapolating scores for the California Stream Condition Index (CSCI).
- SSN models did not support a general distance limit to extrapolation that works in all settings (e.g., “a site score represents the condition of 800 m of a stream”), given the large variability observed among and within watersheds. On the contrary, the limits on extrapolation are more appropriately a site-specific determination.
- SSN models varied greatly among watersheds due to differences in watershed properties, patterns of degradation, and distribution of sampling locations. Models built for one watershed may not generalize to other watersheds, even if they share many environmental characteristics.
- SSN models offer a way to make site-specific and spatially explicit determinations by creating maps of extrapolated CSCI scores along a drainage network, that can support management decisions:
 - Maps may provide confidence in decisions about stream health, and whether they apply to upstream tributaries or downstream reaches.
 - Maps can identify regions where more sampling is required to improve confidence in estimates of condition.
 - Maps can be customized for diverse applications to reflect different levels of confidence they require.
 - Maps can be redrawn to incorporate new data as they become available.

- The drawbacks of a map-based approach are that the models will need to be generated for each watershed. However, the process could be streamlined to reduce the resources required for routine applications.
- Future efforts should explore the ability to 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.

Full text:

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/979_SpatialStatisticaINetworkModel2017.pdf