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Correspondence of biological condition models of California streams at statewide and regional scales

Jason T. May[1], Larry R. Brown[1], Andrew C. Rehn[2], Ian R. Waite[3], Peter R. Ode[2], Raphael D. Mazor[4] & Kenneth C. Schiff[4]

[1]United States Geological Survey, California Water Science Center, Sacramento, CA, USA

[2]Aquatic Bioassessment Laboratory, Water Pollution Control Laboratory, California Department of Fish and Wildlife, Rancho Cordova, CA, USA

[3]United States Geological Survey, Oregon Water Science Center, Portland, OR, USA

[4]Southern California Coastal Water Research Project, Costa Mesa, CA, USA

ABSTRACT

We used boosted regression trees (BRT) to model stream biological condition as measured by benthic macroinvertebrate taxonomic completeness, the ratio of observed to expected (O/E) taxa. Models were developed with and without exclusion of rare taxa at a site. BRT models are robust, requiring few assumption compared with traditional modeling techniques such as multiple linear regression. The BRT models were constructed to provide baseline support to stressor delineation by identifying natural physiographic and human land use gradients affecting stream biological condition statewide and for eight ecological regions within the state, as part of the development of numerical biological objectives for California's wadeable streams. Regions were defined on the basis of ecological, hydrologic, and jurisdictional factors and roughly corresponded with ecoregions. Physiographic and land use variables were derived from geographic information system coverages. The model for the entire state (n=1,386) identified a composite measure of anthropogenic disturbance (the sum of urban, agricultural, and unmanaged roadside vegetation land cover) within the local watershed as the most important variable, explaining 56 % of the variance in O/E values. Models for individual regions explained between 51 and 84 % of the variance in O/E values. Measures of human disturbance were important in the three coastal regions. In the South Coast and Coastal Chaparral, local watershed measures of urbanization were the most important variables related to biological condition, while in the North Coast the composite measure of human disturbance at the watershed scale was most important. In the two mountain regions natural gradients were most important, including slope, precipitation, and temperature. The remaining three regions had relatively small sample sizes ($n \leq 75$ sites) and had models that gave mixed results. Understanding the spatial scale at which land use and land cover affect taxonomic completeness is imperative for sound management. Our results suggest that invertebrate taxonomic completeness is affected by human disturbance at the statewide and regional levels, with some differences among regions in the importance of natural gradients and types of human disturbance. The construction and application of models similar to the ones presented here could be useful in the planning and prioritization of actions for protection and conservation of biodiversity in California streams.