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Comparability of biological assessments derived from predictive models and multimetric indices of increasing geographic scope

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ABSTRACT

As the use of bioassessment techniques expands, the demand for tools that can score biological condition from aquatic community data has spurred the creation of a large number of predictive models (e.g., observed over expected (O/E) indices) and multimetric indices (MMIs). The geographic and environmental scopes of these indices vary widely and coverages often overlap. If indices developed for large, environmentally heterogeneous regions provide results that are equivalent to those developed for smaller regions, then regulatory entities could adopt indices developed for larger regions rather than fund the development of multiple local indices. This potential was evaluated by comparing the performance (precision, bias, responsiveness, and sensitivity) of benthic macroinvertebrate O/E and MMIs developed for California (CA) with indices developed for two large-scale condition assessments of United States (US) streams: the US Environmental Protection Agency's Western Environmental Monitoring and Assessment Program's (WEMAP) stream project and the western portion of the national Wadeable Streams Assessment (WSA-West). Both WSA-West and WEMAP O/E scores were weakly correlated with CA O/E index scores, had lower precision than the CA index, were influenced by two related natural gradients (percent slope and percent fast water habitat) for which the CA index was not, and disagreed with 21 - 22% of impairment decisions derived from the CA index. The WSAWest O/E index produced many fewer impairment decisions than the CA index. In the MMI comparisons, both WEMAP and WSA-West MMI scores were much more strongly associated with CA MMI scores than those found in the O/E comparisons. However, the WSA-West and WEMAP MMIs produced many fewer impairment determinations than the CA MMI. Because the WEMAP and WSA-West indices were biased and differed in responsiveness compared with CA indices, they could produce different estimates of regional condition compared with indices that are calibrated to local conditions. Furthermore, the lower precision of the WEMAP and WSA-West indices compromises their use in site-specific assessments where both precision and accuracy are important. However, because the magnitude of differences in impairment decisions was very sensitive to the thresholds used to define impaired conditions, it may be possible to adjust for some of the systematic differences among the models, thus rendering the larger models more suitable for local application. Future work should focus on identifying the geographic and environmental scale that optimizes index performance, determining the factors that most strongly influence index performance, and identifying ways of more accurately specifying reference condition from geographically extensive sets of reference site data.

Full Text

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