A KANSAS STREAM MACROINVERTEBRATE MMI CALIBRATED TO PREDICTED NATURAL CONDITIONS PER SITE INSTEAD OF DISCRETE SITE CLASSES

The Kansas Department of Health and Environment (KDHE) is responsible for sampling and assessing surface water quality throughout Kansas. The benthic macroinvertebrate (BMI) assemblage and community structure can provide a broad time-integrated measure of environmental conditions for assessing aquatic life uses.

We developed a Macroinvertebrate Multi-Metric Index (MMI) for wadeable streams in Kansas that is a numeric representation of biological conditions based on the combined signals of biological metrics that were found to be responsive to a general stressor gradient. The MMI accounts for natural variability and detects biological departure from least-disturbed reference conditions.

To account for natural biological variability, we used random forest (RF) models to predict metric expectations for each site based on multiple natural environmental variables at least-disturbed reference sites. In the random forest analysis, the classification is continuous, rather than in discrete site classes, and observed metric values are compared to the model-predicted values to evaluate whether each metric is as predicted for for relatively undisturbed settings.

Steps for MMI development included compilation of project data from over 3000 samples and over 700 sites, development of a disturbance index to identify reference and stressed sites, generation of random forest models for each metric, evaluation of the performance of different combinations of metrics, and finally, selection and refinement of the MMI. The input metrics for the final MMI represented four different metric categories (habit, tolerance, composition, and voltinism). Each MMI metric had a random forest model and set of predictor variables, with 12-16 predictor variables per metric. The KS MMI performed well with a Discrimination Efficiency of 78%. Scatterplots and correlation analyses were used to assess the strength and direction of MMI response to disturbance variables. The MMI was correlated with a Biological Condition Gradient independently developed for the Great Plains ecoregions.

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