The Effects of Single vs. Tiered Aquatic Life Uses, Multiple vs. Single Organism Groups and Biocriteria-Based vs. Chemical Criteria-Based Methods on Estimation of Aquatic Life Use Attainment and Impairment

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Biographical Sketches of Authors

Edward T. Rankin is a Senior Research Associate for the Center for Applied Bioassessment & Biocriteria (CABB) in Columbus, Ohio. He previously worked for 18 years for the State of Ohio Environmental Protection Agency as a fishery ecologist in their Ecological Assessment Section. He has worked on projects related to assessing the effects of multiple stressors on aquatic life in streams, development and application of stream habitat assessment methodologies and development and application of biological criteria.

Chris O. Yoder is involved in the national development of biological assessments and biocriteria, including multimetric index development for large rivers and wadeable streams. He is presently the principal investigator of a cooperative agreement with the U.S. EPA, Office of Water for monitoring and assessment, indicators, and biological criteria development and implementation. He was most recently Manager of the Ecological Assessment Section at Ohio EPA (1989 – 2001) and supervisor and staff member since 1976. His experience also includes service on national, regional, and state working groups and committees dealing with monitoring and assessment, environmental indicators, biological assessment, biological criteria, and WQS development and implementation. Recently he served as a member of the National Research Council committee on the role of science in the TMDL process. He has 33 years of experience in the assessment of fish assemblages and other aquatic organism groups, their associated habitats, and 28 years in water quality management including the integration of multiple indicators of stress, exposure, and response.

Abstract

The TMDL program and a myriad of other state water management programs are dependent on the structure of a state's water quality standards program including its aquatic life use structure and the monitoring efforts performed to measure attainment or impairment of these aquatic life goals. The consequences of decisions with regard to the robustness of a monitoring program and the choice of aquatic life goals for waters are not always fully appreciated. In this paper we "deconstructed" Ohio's estimation of impaired waters which is based on tiered aquatic life uses, the use of two organism groups, and a biocriteria-focused decision tree to retrospectively understand the consequences of using a single aquatic life use, a single organism group, and replacement of biocriteria with a focus on chemical surrogates for measuring aquatic life use attainment. When we assumed there was a single aquatic life use for Ohio streams instead of tiered uses only 17.8% of stations now considered to be in a higher tier would be considered impaired, compared to 56.5% of such sites under the existing tiered framework. Conversely, 46% of sites from an existing modified aquatic life use (lower than the interim goal) were considered impaired under a single aquatic life use with vs. about 9% of stations under a tiered use system. When existing water chemistry data alone is used to measure aquatic life impairment over the past 20 years, it overestimated attainment by approximately 30% compared to an existing biocriteria-based aquatic life use estimates during this time period. Similarly, the use of two organism groups documented approximately 20%-30% more impaired sites than the use of a single organism group. This work suggests that a robust monitoring program and well conceived aquatic life uses should be a basic component of any water resource quality effort and the choice of aquatic life uses and monitoring approaches can have important consequences for restoration and protection of aquatic life across the US.