

US EPA Mid-Continent Ecology Division

Research Project Summary

Diagnostic Indicators of Stream Impairment as a Result of Nutrients

Overview

The Clean Water Act requires that numeric criteria be developed for those pollutants that may impair water bodies, and state water quality reports have indicated repeatedly that nutrient overenrichment is a major source of impairment. It was noticed that the "one-size-fits-all" statewide numeric criteria lacked regional flexibility (EPA, 2000; 2002), and they were overprotective in parts of the state but underprotective in other areas, as climatology, physiography, and vegetation type vary across the nation. Appropriately refined nutrient criteria are clearly necessary for ensuring proper protection of water resources. Omernick (2000) delineated the nation into 14 ecoregions based on relative differences in land-use/land cover, land-surface form, geology, physiography, climate, soil, potential natural vegetation, and other environmental characteristics. There still remains great uncertainty regarding what nutrient criteria would be appropriate to protect aquatic life uses in each of the ecoregions. Some reasons for this uncertainty include the following:

- 1) It is difficult to develop consistent relationships between nutrient concentrations or loading rates and algal biomass because of the potentially strong effect of co-variables (e.g., physical scouring from spates, light limitation, nutrient turnover time, grazing, etc.) and potential shifts in limiting nutrients.
- 2) It has been difficult to demonstrate the direct impact of nutrients relative to other stressors such as altered habitat, or the interaction of nutrient effects with that of other stressors. It is difficult to determine the most appropriate measurements for criteria (e.g., the forms of nitrogen [N] and phosphorus [P], secondary effects such as low dissolved oxygen [DO]), or the most appropriate restoration/remediation actions.

On January 9, 2001, EPA announced recommended nutrient ecoregional criteria under Section 304(a) (US EPA 2002). States and tribes are expected to adopt or revise these criteria by 2004, although they may modify their plans after that as new information becomes available. States and tribes may revise the recommended criteria in order to protect designated uses, develop more precise numeric levels on smaller geographic scales, and develop criteria using other scientifically defensible methods (US EPA, 2000). EPA is committed to helping states and tribes in this process to establish the necessary endpoints to determine excess nutrients and prevent further impairment (Grubbs, 2001). To address the uncertainties in regionalization and to help refine stressor response relationships, US EPA Region 5 has provided funding through the Regional Methods Initiatives (RMI) program for a research project to refine classification systems for nutrient criteria development, develop regional nutrient-response relationships, and develop diagnostic indicators of impairment related to eutrophication.

The main goal of this project is to provide information needed by states and tribes to set nutrient criteria at a level appropriately protective of their water bodies' aquatic life uses.

The information that would be generated by this study is critically needed in order for states and tribes to use it to refine their criteria. The objectives of this project include the following:

- 1) To identify streams that respond similarly to nutrient enrichment, because of similarities in water body characteristics (e.g., flow), watershed attributes (e.g., forest fragmentation), and/or the physiographic region (e.g., Lake Superior Clay Plains) in which the stream is located.
- 2) To use bioassessment data to derive diagnostic indicators of nutrient-caused impairment for similar stream classes as above.

Several offshoots of this project have developed. We are collaborating with EPA's Office of Environmental Information to make the regional database developed for this project available to EPA Region 5 and associated states and tribes through a web-based interface with SAS analytical and mapping tools. This will be available through EPA's Regional Science Portal. Nutrient data from the regional database have been summarized for use in an ongoing exercise to rank watersheds in the Upper Mississippi River basin by nutrient concentrations to prioritize watershed management activities.

Key Products

Geo-referenced database of linked hydrology, water quality, biological, habitat, and watershed characteristics data for EPA Region 5 and surrounding states.

Homogeneous climatic region delineations of EPA Region 5 and surrounding States based on cluster analysis and physiography of watersheds.

Relationships between flow regimes, nutrients, periphyton biomass, and biological community metrics.

Diagnostic indicators of stream impairment due to nutrient enrichment.

<http://www.epa.gov/waterscience/standards/nutrient.html>

For further information on this research contact:

Naomi Detenbeck / Jo Thompson / Dave Pfeifer (EPA Region V)
detenbeck.naomi@epa.gov / thompson.jo@epa.gov / pfeifer.david@epa.gov
(218) 529-5204 / (218)-529-5198 / (312)-353-9024