Nutrient-Biota Interactions in Agriculturally Dominated Landscapes: Lessons from the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program

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Biographical Sketch of Author

Mark D. Munn is a stream ecologist with the USGS Washington Water Science Center and has worked on a variety of projects ranging from benthic ecology to contaminants in fish. Since 1992 he has worked for the USGS National Water-Quality Assessment (NAWQA) Program, and is presently the National Team Leader for the Effects of Nutrients on Stream Ecosystems team which is part of NAWQA.

Abstract

Nutrient (nitrogen and phosphorus) enrichment is a leading cause of water quality impairment in the United States, with agricultural activities a major source of nutrients to surface waters. In 2001, the U.S. Geological Survey's National Water-Quality Assessment Program began a study on the effects of nutrient enrichment on stream ecosystems. Eight agriculturally influenced study units were selected; study activities began at five study units in 2001 and at three study units in 2005. Thirty independent, wadeable stream sites distributed along a gradient of nutrient conditions were selected in each study unit. Sites were selected using geodata, predicted nutrient loads and measured nutrient concentrations, habitat, and stream size. Data collected during a single period include nitrogen and phosphorus, biological communities (algae and invertebrates), algal chlorophyll *a*, primary production and respiration, and stream habitat. Riparian and land-use data were obtained using GIS procedures. Additional data to be collected at the 2005 study units include streamflow and seasonal changes in nutrients and biota. Although nutrient and chlorophyll *a* concentrations often are used in developing nutrient criteria, preliminary results from this study indicate a number of issues that need to be considered in agricultural streams: (1) nutrients and chlorophyll *a* often are weakly correlated; (2) biota may reflect nutrient concentrations from an earlier time; (3) physical habitat is a limiting factor for biological communities; (4) nutrient concentrations in many streams exceed biological requirements; and (5) macrophytes may have a greater effect on some streams than do algae. Furthermore, the relation between nutrients and a biological measure may be expressed as a threshold-response curve with threshold concentrations typically less than those measured in agricultural streams. Streams in agriculturally dominated landscapes provide unique opportunities and challenges that must be adequately addressed to establish accurate nutrient enrichment criteria.