The USGS National Water-Quality Assessment Program: Understanding the Effects of Nutrients on the Ecology of Agricultural Streams

Mark D. Munn

U.S. Geological Survey, Washington Water Science Center, 1201 Pacific Ave., Suite 600, Tacoma, WA 98402, mdmunn@usgs.gov

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. The U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program has been studying nutrients in streams and rivers for 15 years for the purpose of understanding land-use effects, loadings, and effects on stream biota. In response to the recognized need for more detailed nutrient-biota studies, NAWQA began an intensive study in 2002 of nutrient-biota interactions in agricultural areas across the Nation. The objective of this study is to improve our understanding of the interactions of nutrients, habitat, and biological community structure (algal/invertebrate assemblages) and function (stream metabolism and nutrient transformations). Each study area selected 30 independent, wadeable streams distributed along a nutrient gradient. Sites were selected using geodata, measured and predicted nutrient loads and concentrations, habitat, and stream size. Five study areas have completed their data collection, and three more are planned to start in 2006. 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 are obtained using GIS procedures. Additional data to be collected in the second group of study units (2006-08) include streamflow for hydrologic disturbance and seasonal changes in nutrients and biota.

Although nutrients (TN and TP) and chlorophyll *a* commonly are used to assess trophic condition of a stream, our study indicates: (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) quantifying primary producers can be complicated in some systems where macrophytes are the dominant primary producer, particularly in ground water or irrigation water fed streams. 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. These models require the recognition that nutrients do not just affect biota, but in fact nutrients, biota and physical processes interact in differing ways depending on the specific situation. Streams in agriculturally dominated landscapes provide unique opportunities and challenges that must be adequately addressed to establish accurate nutrient enrichment criteria.