Biological Responses to Nutrient Enrichment in Streams – a National Perspective

Terry R. Maret[1] and Ian R. Waite[2]
[1] U.S. Geological Survey, Idaho Water Science Center
230 Collins Road
Boise, ID 83702
trmaret@usgs.gov

[2] U.S. Geological Survey, Oregon Water Science Center
2130 SW 5th Avenue
Portland, OR, 97201
iwaite@usgs.gov

In areas of the United States in which agriculture is a major source of nutrients in streams, elevated concentrations of nitrogen and phosphorus are leading causes of water quality impairment. The U.S. Geological Survey's National Water-Quality Assessment Program evaluated nutrient-biota interactions in eight agricultural areas throughout the United States from 2003 to 2007. Each study area included about 30 wadeable stream sites that were selected to capture a broad nutrient gradient. Data on nitrogen and phosphorus, algal and invertebrate communities, benthic and sestonic algal chlorophyll a, and habitat were collected at each site during the growing season. In a national synthesis of the biological communities and associated watershed and habitat data, we evaluated the biological conditions of algal and invertebrate communities through a variety of metrics including those related to deviation from expected regional reference conditions, species richness, and traits of specific taxa. We identified five important findings: (1) biological condition declines with increasing nutrient concentrations, with about two-thirds of all sites having altered biological condition; (2) the strong relation with biological condition and an agricultural intensity index underscores the importance of land management at the watershed scale; (3) patterns of biological responses to increasing nutrients are not consistent across agricultural landscapes; (4) reductions of instream nutrient concentrations may not show desirable improvements in biological condition unless habitat is restored, especially in riparian areas; and (5) seasonal differences in the composition of biological communities can play an important role when interpreting nutrient concentrations and associated biological responses. Excessive concentrations of nutrients in agricultural streams and the complex interactions of nutrient sources, habitat, and biota must be considered if we are to arrive at realistic expectations regarding nutrient criteria and stream restoration.