Assessing the Effects of Nutrients on Agricultural Streams: The Importance of Assessing Both Biological Response and Nutrient Processes

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The use of synthetic fertilizer and animal manure on crops has contributed to substantial growth in agricultural production in the United States. However, it has also led to elevated instream nitrogen and phosphorus concentrations, a leading cause of local and downstream water quality impairments according to the U.S. Environmental Protection Agency. Since 2003, the U.S. Geological Survey's National Water-Quality Assessment Program has studied nutrient-biota interactions in eight agricultural areas across the United States, four located within the Mississippi River Basin. These eight agricultural areas provide a gradient of low to high instream nutrient concentrations. Within each study area, 30 wadable stream sites were selected to capture the broadest possible nutrient gradient in a single ecoregion. Data on nitrogen and phosphorus, algal and invertebrate communities, benthic and sestonic algal chlorophyll *a*, and habitat conditions were collected at each site during the growing season. Stream metabolism and nitrogen processing were assessed at a subset of sites. Results from these studies illustrated that in agricultural streams: (1) nutrient concentrations and algal biomass were rarely correlated because of surplus nutrient supply, habitat limitation, and nutrient-algal interactions; (2) relations between nutrients and algal biomass cannot be found in ecoregions without a sufficient nutrient gradient; 3) high nutrient inputs and reduced retention times overwhelm natural ecosystem functions and lead to a large fraction of the original nitrogen load being exported downstream; 4) primary production is generally limited because of instream habitat conditions; 5) groundwater inflow can be a nitrogen source for an extended period regardless of changes in management practices; and 6) algal assemblages have a stronger response to low-level nutrient enrichment than macroinvertebrate or fish assemblages. These findings highlight the complex interactions between nutrient sources, habitat, and biota that are exacerbated by the excess nutrients in agricultural streams and needs to be considered to realistically develop nutrient criteria and manage stream restoration.