The Use of Calculated Stream Metabolism in Understanding Nutrients in Agricultural Streams

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Biographical Sketch of Author

Jill Frankforter has been a hydrologist with the U.S. Geological Survey, Nebraska Water Science Center since 1992. Within an educational background in biology and aquatic ecology, she is the ecologist for the National Water-Quality Assessment Program's Central Nebraska Basins study unit, and has been involved in the implementation of the Program's study of the effects on nutrient enrichment on stream ecosystems. In addition, she has been the water-quality specialist for the Nebraska Water Science Center since 1999, and has worked on a variety of water-quality related projects.

Holly Weyers is a fisheries ecologist with the U.S. Geological Survey, Delaware Water Science Center. She has been the ecologist for the National Water-Quality Assessment Program's Potomac River Basin and Delmarva Peninsula study unit since 2001. She has been involved in the development and implementation of sampling methods, personnel training, and data interpretation associated with stream metabolism estimates conducted as part the Program's study on the effects of nutrient enrichment on stream ecosystems. In addition, she is currently responsible for continuous, real-time water-quality assessments being conducted on selected streams with the State of Delaware.

Abstract

The development of nutrient criteria for rivers and streams has largely focused on measures of nitrogen, phosphorus, sestonic and periphytic chlorophyll *a*, and turbidity. The relation between concentrations of nutrient species and chlorophyll *a* in nutrient-enriched streams is variable and is influenced by natural and anthropogenic factors. The photosynthetic rate, or primary productivity, is often more sensitive and responsive to variable nutrient levels than is algal biomass (measured as chlorophyll *a*), but the need to normalize data for differences between sites and the analytical difficulty in estimating productivity has limited the use of production in assessments of nutrient enrichment.

The U.S. Geological Survey's National Water-Quality Assessment Program study of the effects of nutrient enrichment on stream ecosystems is intended to expand existing knowledge of the interrelations among nutrient conditions, algal communities, habitat, and stream metabolism. A key objective is to determine the extent to which these relations can be regionalized. Sampling is occurring at approximately 130 sites representing 8 distinct U.S. Environmental Protection Agency aggregated nutrients ecoregions across the Nation. Some of the previously documented difficulties with estimating whole-stream metabolism that are being addressed during this study include: estimation of reaeration; seasonal variability in metabolic processes; the influence of macrophytic metabolism; the quantification of changes in antecedent streamflow; and the analytical difficulty associated with estimates of productivity. Estimates of gross primary production, 24-hour community respiration, and net daily metabolism (net primary productivity) were generated using software developed for the study. These estimates were compared to the biotic community, water-quality, and habitat data to determine which factors are most strongly related to the nutrient conditions within and among selected nutrient ecoregions. These results may then be used in the development of regional nutrient criteria for streams.