Algae–P relationships, thresholds, and frequency distributions guide nutrient criterion development

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Abstract

We used complementary information collected using different conceptual approaches to develop recommendations for a stream nutrient criterion based on responses of algal assemblages to anthropogenic P enrichment. Benthic algal attributes, water chemistry, physical habitat, and human activities in watersheds were measured in streams of the Mid-Atlantic Highlands region as part of the Environmental Monitoring and Assessment Program of the US Environmental Protection Agency. Diatom species composition differed greatly between low- and high-pH reference streams; therefore, analyses for criterion development were limited to a subset of 149 well-buffered streams to control for natural variability among streams caused by pH. Regression models showed that TP concentrations were ~10 µg/L in streams with low levels of human activities in watersheds and that TP increased with % agriculture and urban land uses in watersheds. The 75th percentile at reference sites was 12 µg TP/L. Chlorophyll *a* and ash-free dry mass increased and acid and alkaline phosphatase activities decreased with increasing TP concentration. The number of diatom taxa, evenness, proportion of expected native taxa, and number of high-P taxa increased with TP concentration in streams. In contrast, the number of low-P native taxa and % low-P individuals decreased with increasing TP. Lowess regression and regression tree analysis indicated nonlinear relationships for many diversity indices and attributes of taxonomic composition with respect to TP. Thresholds in these responses occurred between 10 and 20 µg/L and helped justify recommending a P criterion between 10 and 12 µg TP/L to protect high-quality biological conditions in streams of the Mid-Atlantic Highlands.

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