Influence of Nutrients, Habitat, and Streamflow on Indicators of Eutrophication in Agricultural Streams: Applications for Developing Nutrient Criteria

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Nitrogen and Phosphorus are the primary nutrients that are responsible for excessive algal biomass and aquatic plant growth in agricultural streams. However, interaction of nutrients and stream habitat on indicators of eutrophication (algae and aquatic plant growth) are not well understood. The effect of nutrient regimes on stream eutrophication were examined in three major agricultural regions of the United States. Sites within each study area were selected along a nutrient enrichment gradient while minimizing natural variation. A total of 70 wadeable sites were selected with 18 to 30 sites per study area with chemical, physical, and biological variables sampled during a single summer period in 2006 or 2007. Continuous stage and water temperature was collected at each site 30 days prior to sampling to evaluate antecedent conditions. A wide range of concentrations were found for total nitrogen (TN, 0.07-9.61 mg/L) and total phosphorus (TP, 0.002-0.361 mg/L) among all sites. Biotic measures of stream eutrophication including periphytic (RCHL) and sestonic (SCHL) chlorophyll-a, and aquatic macrophyte growth (AQM) were generally not strongly related to concentrations of TN or TP; R^2 values ranged from 0.02 to 0.32. Multiple regression models including nutrients in addition to reach habitat and microhabitat scale variables improved model performance; R^2 values ranged from 0.12 to 0.43. Invertebrate scraper biomass ranged from 0.1 to 25.5 g/m2 for all sites; however, they were not important in the model. An index combining RCHL, SCHL, and AQM is offered as an alternative to evaluate eutrophic status which may be more robust than using individual biotic indicators. A significant ($R^2 = 0.62$, $P < 0.001$) multiple regression model containing TN, TP, percent canopy, median riffle depth, turbidity, daily change in stage, and a high flow index to be important in predicting index score. Filamentous algae and macrophytes were an important component of the plant communities at about 20% of the sites which may be confounding nutrient algal-biomass relations. Study results are discussed in light of developing nutrient criteria for agricultural streams.