A comparison of algal, macroinvertebrate, and fish assemblage indices for assessing low-level nutrient enrichment in wadeable Ozark streams

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Biotic indices for algae, macroinvertebrates, and fish assemblages can be effective for monitoring stream enrichment, but little is known regarding the value of the three assemblages for detecting perturbance as a consequence of low-level nutrient enrichment. In the summer of 2006, we collected nutrient and biotic samples from 30 wadeable Ozark streams that spanned a nutrient-concentration gradient from reference to moderately enriched conditions. Seventy-three algal metrics, 62 macroinvertebrate metrics, and 60 fish metrics were evaluated for each of the three biotic indices. After a group of candidate metrics had been identified with multivariate analysis, correlation procedures and scatter plots were used to identify the four metrics having strongest relations to a nutrient index calculated from log transformed and normalized total nitrogen and total phosphorus concentrations. The four metrics selected for each of the three biotic indices were: algae—the relative abundance of most tolerant diatoms, the combined relative abundance of three species of Cymbella, mesosaprobic algae percent taxa richness, and the relative abundance of diatoms that are obligate nitrogen heterotrophs; macroinvertebrate—the relative abundance of intolerant organisms, Baetidae relative abundance, moderately tolerant taxa richness, and insect biomass; fish—herbivore and detritivore taxa richness, pool species relative abundance, fish catch per unit effort, and black bass (Micropterus spp.) relative abundance.

All three biotic indices were negatively correlated to nutrient concentrations but the algal index had a higher correlation (rho = 0.89) than did the macroinvertebrate and fish indices (rho = 0.63 and 0.58, respectively). Biotic index scores were lowest and nutrient concentrations were highest for streams with basins having the highest poultry and cattle production. Because of the availability of litter for fertilizer and associated increases in grass and hay production, cattle feeding capacity increases with poultry production. Studies are needed that address the synergistic effect of poultry and cattle production on Ozark streams in high production areas before ecological risks can be adequately addressed.