Nitrogen-fixing cyanobacteria (free-living and diatom endosymbionts): their use in southern California stream bioassessment

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ABSTRACT

A weight-of-evidence approach was used to examine how nutrient availability influences stream benthic algal community structure and to validate nutrient-response thresholds in assessing nutrient limitation. Data from 104 southern California streams spanning broad nutrient gradients revealed that relative abundance of N₂-fixing heterocystous cyanobacteria (Nostoc, Calothrix), and diatoms (Epithemia, Rhopalodia)-containing cyanobacterial endosymbionts, decreased with increasing ambient inorganic N concentrations within the low end of the N gradient. Response thresholds for these N₂ fixers were 0.075 mg l⁻¹ NO₃-N, 0.04 mg l⁻¹ NH₄-N, and an N:P ratio (by weight) of 15:1. The NO₃-N threshold was independently validated by observing nitrogenase gene expression using real-time reverse transcriptase PCR. Morphometric analysis of cyanobacterial endosymbionts in Epithemia and Rhopalodia indicated that endosymbiont biovolume per diatom cell decreased with increasing NO₃-N. Our findings indicate that abundance of heterocyst-containing cyanobacteria and endosymbiont-containing diatom cells are good indicators for rapid nutrient biomonitoring. Because heterocystous cyanobacteria and Epithemia/Rhopalodia were not always recorded together at N-limited sites, examining both assemblages jointly may provide a more comprehensive assessment of stream nutrient limitation than using either assemblage alone.

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