



Bloom formation in heterocystic nitrogen-fixing cyanobacteria: The dependence on colony size and zooplankton grazing

Chan, Francis, Michael L. Pace, Robert W. Howarth, Roxanne M. Marino

Limnol. Oceanogr., 49(6), 2004, 2171-2178 | DOI: 10.4319/lo.2004.49.6.2171

ABSTRACT: The success of filamentous nitrogen (N)-fixing cyanobacteria in productive, transiently N-limited freshwaters reflects, in large part, their ability to produce and sustain the activities of specialized N-fixing heterocyst cells. Heterocyst production is variable, and the responses of planktonic cyanobacterial blooms to N limitation differ markedly among systems. Temporal variations in cyanobacteria colony size may determine both heterocyst production and sensitivity to top-down control by zooplankton grazers. We promoted the development of cyanobacterial blooms through phosphorus additions and trophic manipulations in freshwater ponds, to test the role of colony size structure in regulating N-fixer bloom development. The in situ growth and heterocyst production of *Anabaena* spp. were strongly linked to variations in colonial filament size. *Anabaena* spp. initially recruited to the water column as short and poorly heterocysted filaments, exhibiting low (mean = 0.09 d⁻¹) rates of population growth. The growth rate increased by more than fourfold (mean = 0.39 d⁻¹) with the onset of colony elongation and heterocyst production, which resulted in rapid seasonal build-ups of cyanobacterial cells (>10⁶ cells ml⁻¹). Size-dependent growth was also important in determining the outcome of zooplankton-cyanobacteria interactions. In microcosm experiments, zooplankton consumers directly grazed on *Anabaena* spp. colonies, reduced the mean filament size, and reduced the efficiency with which heterocysts fixed nitrogen. These results suggest that colony size is a fundamental mechanism that link cellular physiological constraints to variations in trophic controls and the responses of aquatic systems to N limitation.

Article Links

[Download Full-text PDF](#)

[Return to Table of Contents](#)

Please Note

Articles in L&O appear in PDF format. Open access articles may be freely downloaded by anyone. Other articles are available for download to subscribers only, or may be purchased for \$10 per article. All L&O articles are moved into Open Access after three years.

