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Small-scale shear effects on heterocystous cyanobacteria

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ABSTRACT: Planktonic, filamentous, heterocystous cyanobacteria form blooms in certain nitrogenlimited ecosystems but are absent or rare in others that seem to have suitable environmental conditions. We tested the hypothesis that small scale shear affects physiological activities and morphology of heterocystous cyanobacteria in high turbulence environments. Using Taylor-Couette flow to generate small-scale shear, we conducted one set of experiments on cultures of two strains of Baltic Sea *Nodularia* and a complementary set of experiments using natural Baltic Sea phytoplankton assemblages. Experiments were run at various shear durations (1-72 h) and levels (2.2-18 s⁻¹), corresponding to energy dissipation rates in the upper mixed layer from moderate to strong winds. The effect of shear on nitrogenase activity (NA), CO, fixation, pH, dissolved inorganic carbon, and cyanobacterial filament length was tested. Results from the culture experiments showed that shear had a negative effect on NA and CO, fixation for both *Nodularia* strains and that filament length decreased for one of them. The lower limit for shear effects on NA and CO, fixation appeared to be less than 2.2 s.". Results from the experiments on natural phytoplankton assemblages from the Baltic Sea showed that both CO, fixation (reflecting cyanobacterial photosynthetic activity) and NA decreased in response to shear. However, shear did not affect CO, fixation in the <2-µm size fraction. Aphanizomenon and Anabaena filaments fragmented under shear rates (2.2 s", 12 h) that did not affect Nodularia filament length. These results suggest that small-scale shear imposes a control on cyanobacterial activity and morphology and that this control appears to be genus and species specific.

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