Copper toxicity and cyanobacteria ecology in the Sargasso Sea

Mann, Elizabeth L., Nathan Ahlgren, James W. Moffett, Sallie W. Chisholm

Limnol. Oceanogr., 47(4), 2002, 976-988 | DOI: 10.4319/lo.2002.47.4.0976

ABSTRACT: The closely related cyanobacteria *Synechococcus* and *Prochlorococcus* have different distributions in stratified water columns in the northern Sargasso Sea. The abundance of *Synechococcus* is relatively uniform with depth, but *Prochlorococcus* cell numbers are low within shallow mixed layers and high in and below the thermocline. Because free cupric ion (free Cu^{2+}) concentrations are high (up to 6 pM) in shallow mixed layers and lower in deeper water, there is an inverse relationship between *Prochlorococcus* densities and the free Cu^{2+} concentration. We explored the possibility of a causal underpinning for this relationship by examining the relative copper sensitivities of *Prochlorococcus* and *Synechococcus* in cultures and field populations. *Prochlorococcus* isolates from both the high- and low-light adapted ecotypes were inhibited at free Cu^{2+} concentrations that had no effect on *Synechococcus*. However, the high-light adapted strains were more copper resistant than their low-light adapted counterparts. When copper was added to *Prochlorococcus* from environments where the in situ free Cu^{2+} was low (in deeply mixed water columns and below the mixed layer in stratified conditions), net growth rates were substantially reduced and cells arrested in the G_1 and early S phases of the cell cycle. *Prochlorococcus* in shallow mixed layers were less sensitive to copper and were probably members of the copper-resistant high-light adapted ecotype. *Synechococcus* were relatively copper resistant across a range of environments in the Sargasso Sea. These observations are consistent with our hypothesis that copper plays a role in cyanobacteria ecology in the Sargasso Sea.

Article Links

Download Full-text PDF

Return to Table of Contents