# Emergent stoichiometry of marine phytoplankton and implications for nutrient cycling

THOMAS S. WEBER[1] AND CURTIS A. DEUTSCH[2]

[1]School of Oceanography, University of Washington, Seattle, WA 89195. tsweber@uw.edu

[2]School of Oceanography, University of Washington, Seattle, WA 89195. cdeutsch@uw.edu

The ocean nitrogen (N) and phosphorous (P) cycles are closely coupled by the metabolic requirements of phytoplankton at the base of the marine food chain. The formation and degradation of organic matter with average composition of 16N:1P (the "Redfield ratio") maintains a strong correlation between the dissolved nutrients nitrate and phosphate. On millennial times, the oceanic inventories of those nutrients are held close to Redfield proportions by selection for nitrogen-fixing organisms when N is limiting.

Over recent years, data compilations and diagnostic models have revealed large-scale variations in nutrient utilization ratios between marine biomes, suggesting the Redfield ratio emerges as a global average across a stoichiometrically diverse biota. We have developed a new physiological model to understand spatial and temporal variations in phytoplankton N:P ratios. Model organisms allocate their resources between classes of cellular machinery that perform different growth-limiting functions and differ in their elemental composition. We show that length of the growing season, mixed layer depth, and stoichiometry of the nutrient supply are key factors that select between growth strategies and N:P ratios.

We re-examine nutrient limitation, controls on $N_2$-fixation, and the regulation of ocean nutrient reservoirs in light of these findings, and highlight new avenues for future research.