



Phosphorus availability, phytoplankton community dynamics, and taxon-specific phosphorus status in the Gulf of Aqaba, Red Sea

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ABSTRACT: The relationships among phytoplankton taxon-specific phosphorus-status, phytoplankton community composition, and nutrient levels were assessed over three seasons in the Gulf of Aqaba, Red Sea. During summer and fall, stratified surface waters were depleted of nutrients, and picophytoplankton populations comprised the majority of cells (80% and 88%, respectively). In winter, surface nutrient concentrations were higher and larger phytoplankton were more abundant (63%). Cell-specific alkaline phosphatase activity (APA) derived from enzyme-labeled fluorescence was consistently low (<5%) in the picophytoplankton population throughout the year, whereas larger cells expressed increased APA (up to 68% labeling in some taxa) during the summer and fall but less in the winter. A nutrient addition bioassay during the fall showed that after addition of orthophosphate along with a nitrogen source, APA in larger cells was reduced by half relative to the control, whereas the APA of picophytoplankton groups remained low (<1%) across all treatments. These results indicate that the most abundant phytoplankton in the gulf are not limited by orthophosphate, and only some subpopulations (particularly of larger cells) exhibit orthophosphate limitation throughout the year, and more so in the summer and fall. Our results indicate that orthophosphate availability influences phytoplankton ecology, correlating with shifts in phytoplankton community structure and the nutrient status of individual cells. The role of dissolved organic phosphorus as an important phosphorus source for marine phytoplankton in oligotrophic settings and the need for evaluating nutrient limitation at the taxa and/or single cell level (rather than inferring it from nutrient concentrations and ratios or bulk enzyme activity measurements) are highlighted.

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