

# Experimental investigation of taxon-specific response of alkaline phosphatase activity in natural freshwater phytoplankton

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ABSTRACT: It is widely accepted that alkaline phosphatase activity (APA) is an efficient indicator of phosphate limitation in freshwater phytoplankton communities. In this study, we investigated whether the response in APA to phosphate limitation differs among the taxa in a mixed phytoplankton assemblage. We used the new enzyme-labeled fluorescence (ELF) technique, which allows microscopic detection of phosphate limitation in individual cells of multiple species. The most prominent findings of this study were that alkaline phosphatase (AP) was induced in many, but not all taxa and that different taxa, as well as different cells within a single taxon, experienced different degrees of phosphate stress under the same environmental conditions. Our approach was to manipulate the limiting nutrient in a natural freshwater phytoplankton community by incubating lake water in the laboratory. We induced nitrogen (N) or phosphate limitation through additions of inorganic nutrients. Both the ELF assay and bulk APA indicated that the lake phytoplankton were not phosphate limited at the start of the experiment. During the experiment, several chlorophyte taxa (e.g., *Eudorina* and an unidentified solitary spiny coccoid) were driven to phosphate limitation when inorganic N was added, as evidenced by a higher percentage of ELF-labeled cells relative to controls, whereas other chlorophyte taxa such as *Actinastrum* and *Dictyosphaerium* were not phosphate stressed under these conditions. In the phosphate-limited treatments, little or no ELF labeling was observed in any cyanobacterial taxa. Furthermore, all taxa observed after the ELF labeling procedure (>10-μm fraction) were labeled with ELF at least on one occasion, demonstrating the wide applicability of the ELF method. By using ELF labeling in tandem with bulk APA, the resolution and analysis of phosphate limitation was increased, allowing the identification of specific phosphate-stressed taxa.

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