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Flow-cytometric mapping provides novel insights into the seasonal and vertical distributions of freshwater autotrophic picoplankton

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ABSTRACT: This is the first study using flow cytometry to characterize the population dynamics of freshwater autotrophic picoplankton (APP) over a full seasonal cycle, the goal of which was to accurately quantify and qualify the natural APP populations in relation to major environmental parameters. In particular, we wanted to test current assumptions about the seasonal succession of prokaryotic and eukaryotic picoplankton cells, including the relationship between solitary picocyanobacteria and microcolonies. Using flow cytometry, we were able to efficiently characterize the abundances of 4 lake APP assemblages in Lake Mondsee, including that of a solitary picocyanobacterial population exhibiting high 'side scatter' values. Such cells were not readily enumerated by epifluorescence microscopy. Unlike Lakes Constance and Maggiore, we found no evidence of a spring peak in solitary picocyanobacteria — we propose that the lack of a spring peak in Lake Mondsee was due to weak stratification in March-April and relatively deep vertical mixing. Since summer declines in the abundance of solitary picocyanobacteria were associated with extended periods of reduced light availability, it is likely that such declines were in part due to low relative growth rates. Finally, we argue that the formation of microcolonies by picocyanobacteria is unlikely to be a strategy for more efficient nutrient recycling (e.g. Stockner & Antia 1986). Rather, we suggest that microcolonies reach high concentrations in surface and near-surface waters due to the production of a photosynthate-rich mucilage resulting from active photosynthesis during periods of severe nutrient deficiency.

KEY WORDS: Microcolonies · Picocyanobacteria · Eukaryotic picoplankton · Flow cytometry · Sorting · Lakes · Calcite · Calcium carbonate