Short-term responses of natural phytoplankton communities to nutrient supply and experimental unit size

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Scientific evidence highlights the importance of phytoplankton cell size in competitive and coexistence dynamics, which are still not completely clarified. Theoretical frameworks predict that smaller cells are favoured under low nutrient conditions due to higher surface-to-volume ratios, while larger cells dominate when resources are abundant. Also, size and shape of phytoplankton cells affect their ability to move within the water column, consequently increasing their capacity to capture available nutrients more successfully.

In this study, we examined the combined effects of experimental unit size and nutrient supply on phytoplankton community composition and size structure. Water samples from the Acquatina lagoon were used to fill experimental microcosms of 0.5, 0.8, and 1.4 L, supplied with different nutrient concentrations, control, 1.6, and 16.1 mM, with three replicates per treatment over 7 days. Total and size-fractionated (pico-, nano-, microphytoplankton) chlorophyll a, biomass, cell density, taxonomic composition, and diversity were analysed at the start and at the end of the experiment to assess changes across treatments.

Results show that total and size-fractionated chlorophyll a increased in response to both nutrient enrichment and increasing experimental volume, also in the control. Specifically, maximum values were recorded at the highest nutrient concentration (16.1 mM) and in the largest experimental units (1,4 L). Additionally, increasing experimental volume promoted the dominance of microphytoplankton and favoured cylindrical shape morphologies. Also, the increase in experimental unit size was not associated with a corresponding rise in taxonomic richness.
These results suggest that larger species may exploit spatial resources more efficiently, presumably due to the relationship between cell size and sedimentation rate.

Overall, this study underlines the combined effect of experimental unit size and nutrient supply on phytoplankton community structure, emphasising the role of size as key trait determining phytoplankton coexistence mechanisms through interactions between resource availability and spatial dynamics.