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Niche differentiation in the light spectrum promotes coexistence of phytoplankton species: a spatial modelling approach

The paradox of the plankton highlights the apparent contradiction between Gause's law of competitive exclusion and the observed diversity of phytoplankton. It is well known that phytoplankton dynamics depend heavily on two main resources: light and nutrients. Here we treat light as a continuum of resources rather than a single resource by considering the visible light spectrum and its attenuation through the water column. We propose a spatially explicit reaction-diffusion-advection model to explore under what circumstance coexistence is possible from mathematical and biological perspectives. Furthermore, we provide biological context as to when coexistence is expected based on the degree of niche differentiation within the light spectrum and overall turbidity of the water.