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Response of plankton community structure to temporal heterogeneity and productivity.

This thesis investigates the effects of different frequencies of temporal heterogeneity in vertical mixing on diversity and composition of phytoplankton communities. I examine the issue theoretically and experimentally in lake mesocosms for systems of different average productivity and for communities embedded within food webs of increasing complexity.

The stochastic resource competition model shows that temporal heterogeneity in nutrient supply can be a feasible mechanism by which plankton community diversity can be enhanced, mainly because demographic stochasticity can lead to a storage effect that precludes competitive exclusion. Responses by phytoplankton communities in oligotrophic Placid Lake to different experimental frequencies of vertical mixing depend on the nutrient status of the system and on the structure of higher trophic levels. Major effects of mixing on phytoplankton communities occur with enrichment, with shifts in community structure to larger, more filamentous types and to more diverse communities with increased water column stability (or decreased frequency of perturbations). Under low nutrient conditions, but when *Daphnia* was present, phytoplankton community structure also responded to different frequencies of mixing with lower community richness with more frequent mixing. This was attributed to an increase in predator-prey encounter rates with more frequent mixing. The inclusion of the entire natural plankton community led to a diminished response to frequency of mixing in phytoplankton, but to size-structure shifts in the top trophic level of invertebrate predators (i.e. *Chaborus* sp.). The results of this study suggest that temporal heterogeneity arising in lakes as a result of storm events may have little influence in oligotrophic systems, contrary to the general conclusions drawn mainly from eutrophic laboratory systems that predict large responses in phytoplankton community structure.