Coastal phytoplankton community dynamics and coexistence

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Abstract

A major puzzle in ecology is the continued coexistence of species-rich communities of primary producers, such as phytoplankton, in spite of the likely competition for shared resources, that in theory often leads to competitive exclusion. To investigate what drives phytoplankton community dynamics and allows coexistence, we translated the hypotheses of population dynamics models for phytoplankton communities into multivariate time series models, allowing interactions between species or genera, as well as forcing by abiotic variables. We then performed a statistical analysis of a long-term ($>$ 20 year) coastal survey of phytoplankton, with counts every two weeks. The statistical models reveal that net competition (for nutrients or other resources) between groups seems rather weak in the field, unlike what is found in more controlled environments. While fluctuating environments rather than niches differences are usually invoked to solve the "plankton paradox", more elaborate statistical models specifically developed for fluctuating environments, mimicking the storage effect or relative nonlinearities, seem also inappropriate for this coastal community. Here, strong intragroup density-dependence dominate while interactions between groups (genera) are weak, often positive, and fluctuate little over time. This points to other drivers of coexistence such as predation or microscale spatial structure, for which we highlight the modelling and data collection implications.

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