Eco-evolutionary responses of phytoplankton to global change

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Introduction

Take a long, deep breath. Now slowly let it out and take another. That second breath was brought to you by phytoplankton, the microscopic photosynthesizers found in almost all open water on Earth. In addition to producing nearly half of the oxygen you breathe, phytoplankton are the foundation of most pelagic food webs; they are the trees of the seas.

Recent studies, including some from the Litchman lab at KBS, have projected massive changes in phytoplankton communities in the world's oceans over the next century, due to climate change. However, some phytoplankton may have one last trick up their sleeves: massive population sizes and extremely high reproductive rates allow phytoplankton to adapt evolutionarily to rising temperatures at rates unattainable to larger, slower-growing organisms.

In the Litchman lab, we are currently evolving replicate populations of the marine diatom (a type of phytoplankton) *Thalassiosira pseudonana* at temperatures below and above its optimal temperature for growth. After ~450 generations, we have begun to observe some exciting trends (see Danny's website for some details). However, much work remains to be done to thoroughly evaluate the physiological changes that have (or have not) occurred as a result of this thermal adaptation. For example, we are planning experiments to evaluate changes in how (and how well) *T. pseudonana* acquires and stores carbon and nitrogen at different temperatures. How cold- and warm-adapted phytoplankton acclimate to novel temperature environments through phenotypic plasticity (non-genetic change) is also a major gap in our knowledge that requires exploration. Finally, we have begun planning experiments to determine whether solar ultraviolet radiation affects rates of thermal adaptation via mutagenesis.

All of these questions are on the agenda for the coming year, and with some luck, next summer will be an exciting period of rapid advancement on this project. An REU student in our lab should be open to pursuing any one of the above questions (or even another, related question), as we are not yet sure which project(s) we will be focusing on next summer. This is a research-intensive fellowship, and the student will be required to spend at least 40 hours per week in the lab at KBS between May 23rd and August 5th. While not required, a strong background in mathematics, especially calculus and/or statistics, is preferred. The successful applicant should demonstrate focus, responsibility, and enthusiasm for learning new things. There will be ample opportunity to develop technical lab skills (e.g. nutrient analysis, spectroscopy, algal culture), and some experimental design, math, and programming skills as well! Depending on the success of the project, we encourage students to maintain collaborations with our lab after the summer is over, and co-authorships on peer-reviewed publications are possible. We look forward to reading your application!