Lighting the Way to Understanding Our Oceans

How light can significantly affect the critical roles phytoplankton play in the marine ecosystem

Diatoms, photosynthetic algae capable of generating 40% of the ocean's oxygen supply and that in every fifth breath you take, are invaluable to supporting life as we know it. Living in fresh and salt waters all over the world, their incredible productivity rivals that of all the Earth's rainforests combined. Diatoms are primary producers, using CO_2 and sunlight to generate oxygen. Understanding how diatoms respond to environmental se changes in sunlight available, are essential to predicting their contributions to their ecosystems.

As the main energy source for primary production, light affects the rate of photosynthesis in diatoms. If light is limited, diatoms can become stressed out, and if they are not able to respond appropriately or quickly enough, the population will die. However, diatoms are incredibly resilient and adaptable organisms, surviving in waters all over the world under a huge range of gtemperature variation, nutrient conditions, light exposures, and other stresses. So how, under these extreme and variable conditions, are diatoms still thriving worldwide?

Emily Spiegel, an intern with NSF's Research Experiences for Undergraduates (REU) at the College of Charleston and the Hollings Marine Laboratory uncovered evidence of a stress response in a major polar diatom, *Fragilariopsis cylindrus,* found in the harsh environments of the arctic and Antarctic. As winter approaches in the poles, it heralds months of complete darkness. To compensate for the loss of a key factor in photosynthesis, it seems this cold-loving diatom begins to reproduce sexually, as opposed to its normal asexual reproduction. Asexual growth, in which an organism divides continuously into smaller clones of itself, requires many resources to fuel a high turnover. Sexual reproduction, on the other hand, produces fewer cells in more time. While the population size will shrink if reproducing sexually, the cells that are produced are better able to survive because there is less competition for limited resources.

What does a regular, seasonal decrease in diatom population mean for the ecosystems that rely on them? Well for one, it means there are a lot less diatoms available as a food source in these months, which can majorly affect the growth of those organisms that dependent on this easy, free-floating snack.

Additionally, this diapause may affect another important job that diatom typically do for their habitat: removing carbon dioxide from the atmosphere in a process known as carbon fixation. As it turns out, Spiegel found that along with inducing a sexual diapause in diatoms, limited light exposure also reduced their ability to fix carbon from the atmosphere. This has major implications for predicting how well the ocean is removing CO_2 from our atmosphere throughout the year. Removing carbon dioxide from the atmosphere is one of the ocean's principal roles, and given current trends in rising CO_2, reaching dangerously high levels in our atmosphere, it's vital to understand all factors influencing this role. As Dr. Peter Lee of the lab said, "Diatoms are super versatile organisms, and for diatoms that live in the polar regions and experience different conditions of light exposure, understanding how their metabolism changes during the polar night is critical for refining global carbon models."

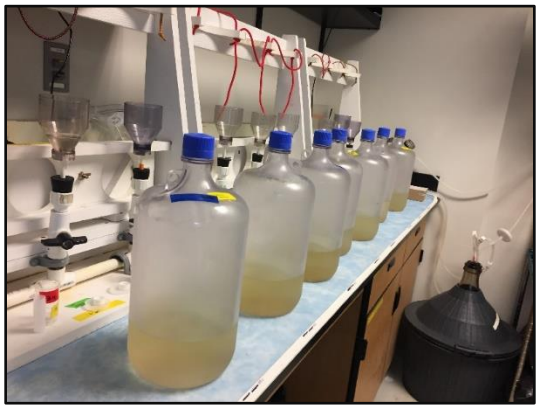

Image 1 (above): Sampling. Populations of the *F. cylindrus* diatom were sampled daily for growth parameters and genetic analysis.

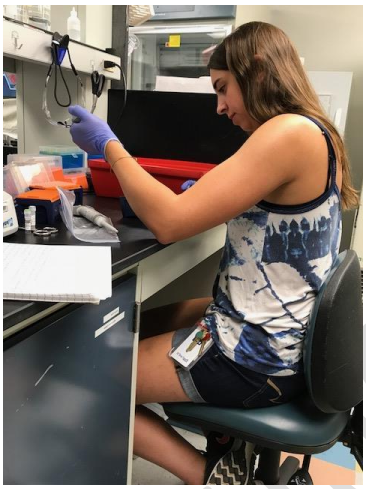

Image 2 (left): Genetic Analysis. Researchers utilized cutting-edge analysis machinery from Nanostring Technologies® to understand the stress response of a polar diatom.

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For more information, please see the following resources:
http://biology.cofc.edu/about-the-department/faculty-staff-listing/lee-peter.php