Chromatic Light Adaptation in Phytoplankton

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Introduction

Phytoplankton is the main source of primary production in the oceans. It requires both the sunlight from the surface and the nutrients generally found a bit deeper in the water column in order to photosynthesize. At the depth where the phytoplankton has found its happy medium, the water has filtered out most lights except for those in the blue/green range (475-530 nm). Putting filters around each individual flask allows us to manipulate the wavelengths and intensity of light reaching the phytoplankton itself. By measuring the chlorophyll concentrations, we can determine the growth rates of the phytoplankton in each light condition.

Questions:
1. How do different wavelengths of light affect phytoplankton growth?
2. How do different light intensities affect phytoplankton growth?

Methods

We ran this experiment twice: once with the wild culture we filtered and concentrated that was collected off the dock at the Grice Marine Lab, and the other was the monoculture of Amphidinium sp.

- Wrapped 9 flat culture flasks in colored cellophane (3 red, 3 blue, and 3 green)
- Wrapped 3 in a double layer of mesh screen to act as shading, and left 3 flasks unwrapped for the control
- Filled each jar with 200 ml of phytoplankton solution (either wild or monoculture)
- Filtered samples of 25 ml of solution twice a week for 2 weeks
- Froze the filters until 24 hours before we ran the samples, at which point we added 5 ml of acetone
- Measured chlorophyll α levels using a fluorometer after all samples were collected
- For the wild culture we also ran a composition analysis by filling a vial from each flask every sample day, placing 6 drops of lugol in each, and using a microscope to determine the composition of a small sample pulled from each vial and placed on a well slide.

Results

Wild

- The visible light section of the electromagnetic spectrum highlighted with the wavelengths of light filtered.
- The provided sunlight and generally a population sunlight was not. It was the necessary nutrients to grow and was unable to obtain them through the color filters, resulting in no increase in growth. The monoculture, being provided with nutrients, helps form a better understanding of the phytoplankton’s response to each individual wavelength.
- The exponential growth in the control as opposed to the filtered treatments shows that any type of obstruction to the light greatly impacts the growth in a negative fashion.
- Of the filtered treatments, the growth was most positively affected by the green filter and least positively affected by the red filter, with the blue and shaded filters falling in between.

Monoculture

- The monoculture was provided with nutrients whereas the wild population was not. It is possible that the phytoplankton collected from the wild were lacking the necessary nutrients to grow and was unable to obtain them through the color filters, resulting in no increase in growth.

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References

