Viral Updates Week 3

(summary of Behrenfeld et al)

**Context**

Past theory proposed a way to describe the abundance of phytoplankton of different sizes in the ocean based on two factors: turbulence and nutrient availability. The theory predicts turbulence prevents larger cells from sinking to a depth where they no longer receive sunlight to photosynthesize. Larger phytoplankton also grow faster in the presence of ample nutrients than smaller phytoplankton. Therefore, larger species are predicted to comprise the majority of phytoplankton in regions with high turbulence and high nutrients, such as the Southern Ocean by Antarctica. In this paper, Behrenfeld et al suggest a different way to view phytoplankton abundances that does not involve competition amongst phytoplankton for nutrients or the turbulence in the ocean, but rather how size effects predator and prey interactions, and how well phytoplankton respond to sudden changes in their environment.

Behrenfeld et al use a theoretical model to study a food web with phytoplankton (prey) and zooplanktons (predators) of different sizes. In this model, smaller zooplankton were limited to eating smaller phytoplankton, but larger zooplankton could eat small to large phytoplankton. Using these assumptions, the authors were able to calculate how many phytoplankton there should be across different sizes. They compared their calculations to global observations of phytoplankton size distributions. ~~W~~hile models based on competition for nutrients underestimate the relative proportion of small phytoplankton, Behrenfeld et al’s model does not.

It is important to note that Behrenfeld’s model does not take into account seasonal changes in phytoplankton communities called ‘blooms.’ Blooms occur when changes in ocean mixing provide additional nutrients to the surface, ‘fertilizing’ phytoplankton to the point where blooms can be seen from [space](https://earthobservatory.nasa.gov/images/146897/channeling-a-bloom). The authors adjust their model to explain seasonal blooms. While phytoplankton can respond more or less immediately to nutrient fertilization, predators have a lag time before they start eating more. The authors claim that small predators can respond to changes in food availability quickly while it takes longer for larger predators to respond to their environments. The slow response of large zooplankton gives an advantage to large phytoplankton, who don’t face increased grazing pressure until long after smaller phytoplankton do.

Traditional models claim competition plays a primary role in structuring phytoplankton communities. This study veers from traditional models and suggests zooplankton predation structures phytoplankton communities. Their model could sufficiently explain real world observations of phytoplankton communities in global observations, encouraging future research on phytoplankton community assembly to pay increased attention to predation and not just competition for nutrients.

**Main Bullet Points:**

* The model the authors present sufficiently explains real world observations of phytoplankton abundance in global ocean waters.
* There are more small phytoplankton than large ones regardless of how much nutrients there are in a specific ocean region.
* Competition and nutrient availability play less of a role in phytoplankton abundance than the size of predators eating them.

**Glossary:**

* Phytoplankton – Small organisms in water that can photosynthesize.
* Zooplankton – Organisms that feed on phytoplankton.
* Mixing