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(Some abstracts have been withheld pending pub-cation.)

Determining the interrelationship between growth rate and Si-ca content of diatoms and the grazing rates of mesozooplankton

Alexis Gillmore, Estrella Mountain Community College
Bigelow Mentor: Dr. David Fields

The relationship between marine phytoplankton and marine zooplankton is essential to oceanic and atmospheric carbon cycles. Among phytoplankton, diatoms contribute up to 40% of all oceanic primary production and are a main food source for zooplankton. As environmental conditions change, however, the characteristics of diatoms may be altered in ways that affect the grazing behavior of zooplankton, changing the balance of oceanic carbon sequestration. This study exposed 3 species of diatoms (Thalassiosira weissflogii, Thalassiosira pseudonana and Phaeodactylum tricornutum) to different -ght levels to determine if biogenic si-ca content within the cell was affected by growth rate. Grazing experiments were then conducted to examine if biogenic si-ca content affects ingestion rates by the marine copepod Acartia tonsa. Our results show that growth rate is directly proportional to -ght levels: as irradiance increases, the growth rate of the culture increases. The bSi content of cells, however, is inversely related to growth rate in the two Thalassiosira spp. When P. tricornutum wastested it was found that in this species there is no relationship between growth rate and si-ca content. When A. tonsa cultures were exposed to T. weissflogii of different bSi contents, grazing was 5x greater for food with a low bSi content than for food with a higher bSi content. This suggests that copepods may select diatoms for food based upon bSi content.

The relationship between biogenic si-ca (BSi), diatom concentration, and temperature in the Gulf of Maine

Amanda Graumann, University of Wisconsin, Superior
Bigelow Mentor: Dr. Wil-am Balch

The Gulf of Maine North Atlantic Time Series (GNATS) investigates phytoplankton abundance, bio-optical properties, biomass, and carbon fixation across the GoM, which are important to the biogeochemistry of this productive Shelf ecosystem. Diatoms produce BSi incorporating it into their frustules which serves as a ballast mineral. Diatoms help drive the ocean biological pump by transporting organic carbon from the ocean surface to the ocean floor. BSi, particle size spectra, particle image files and cell counts were collected and examined at nine discrete sites across the GoM between Portland, Maine and Yarmouth, Nova Scotia, on 5 July 2009. The west-most site BSi concentration was 2000 nmol/L higher than the other eight sites. High values -kely resulted from heavy rainfall in the weeks prior to samp-ng with possible export of si-ca rich sediments from local rivers. Diatom biomass was highest closest to Yarmouth, N.S., where Scotia Shelf waters were nitrate and

phosphorous-rich. Si:C molar ratios of diatoms, however, showed values highest at the first and fifth stations. The fifth station was in the Jordan Basin water which has had elevated Si(OH)4:NO3 ratios, despite low absolute concentrations of nitrate and phosphate. Elevated Si(OH)4:NO3 ratios may have allowed the diatoms to generate thicker frustules, increasing the Si:C ratio. Higher Si:C ratios may have resulted from high concentrations of detrital Si. Si:C molar ratios also showed a significant exponential increase with surface seawater temperature, which may have been associated with differences in diatom species growing in the water masses or temperature-dependent physiological processes.

Iron Enrichment: Natural Causes & Anthropogenic Effects

Andrew R. Gross, Pennsylvania State University
Bigelow Mentors: Dr. Joaquim Goes, Dr. Helga do Rosario Gomes, Ms. Stacey Keith

Iron is a crucial micronutrient needed from the growth of phytoplankton. One third of the world's oceans are low chlorophyll regions despite high concentrations of nutrients -ke nitrogen, and it is widely be-eved that iron is the -miting agent. The northern Pacific ocean is one of the largest high nutrient/low chlorophyll regions in the western hemisphere, while the nearby Bering sea is highly productive. To test the effects of iron enrichment on phytoplankton growth, water samples were collected from the north Pacific ocean and spiked with dissolved iron. To give a frame of reference and study the process by which non-iron -mited waters gain iron, the process was repeated s-ghtly north in waters with higher productivity.

Ci-ate Time Series From a Long-term Dock Study

Ashley Couture, University of Maine, Machias
Bigelow Mentor: Dr. Michael Sieracki

Data from a long term Dock Study was used to assess the composition and concentration of ci-ates present in the water column over time in West Boothbay Harbor, Maine. Ci-ates are single-celled organisms that are characterized by the presence of ci-a, which assist in movement and feeding. They can be autotrophic, heterotrophic or mixotrophic. In addition to the weekly Dock Study data, daily samples were also collected. Samples were collected using a Niskin bottle lowered to a meter depth. Images and counts from an imaging flow cytometer (FlowCAM) assisted in classifying the different types of ci-ates. Comparison of the autoimage and fluorescence modes on the FlowCAM shows that there is a positive correlation between the two modes. The fluorescent particle, Laboea, shows this well by its location in comparison with a 1:1 -ne. Annual results show that there is a seasonal trend in ci-ate concentrations with more present during the warmer months. This could be because their prey, bacteria and plankton, are abundant too. Myrionecta rubra may be able to survive better in winter because it is a mixotroph, while the heterotrophic Strombidiid/Strobi-diid family depends on the presence of organic nutrients for survival. Daily data shows differences similar to the annual data

indicating that the -fe cycle of ci-ates could be on an even smaller time scale. For further work, smaller samp-ng times could be used to try to observe more gradual changes in ci-ate populations.

A Time Course Study of Bacterial Community Dynamics

David Brazel, Colby College

Bigelow Mentor: Dr. Ramunas Stepanauskasp-fe Bacteria are now acknowledged to be ubiquitous in and essential to oceanic environments. Flow cytometry has been used to estimate that 1 mL of seawater contains 105 – 106 bacteria. While bacterial communities are known to play key roles in marine ecosystems and in geochemical and c-mate processes, the interactions between bacterial communities and physical factors have not been well characterized. The aim of my study was to test the hypothesis that weather has a significant effect on the metabo-c activity and taxonomic composition of coastal bacterioplankton. The Bigelow Laboratory for Ocean Sciences has been performing a weekly water collection for over 10 years. The weekly samples were subjected to microbiological and chemical analyses and correlated with weather data. We used preserved samples to perform a metabo-c analysis and bacterial community fingerprinting. The metabo-c analysis was achieved through 5-cyano-2,3-ditolyl tetrazo-um chloride (CTC) staining. CTC is a non-fluorescent, soluble compound that is reduced to form a fluorescent, insoluble compound. CTC will form fluorescent deposits in cells with active electron transport chains. Environmental samples stained with CTC were then analyzed with a flow cytometer to obtain counts and concentrations of metabo-cally active cells. Terminal Restriction Fragment Length Polymorphism (T-RFLP) analysis is a community fingerprinting method based on restriction enzyme digestion of fluorescently labeled copies of 16S rDNA. The resulting labeled fragments are analyzed by a DNA sequencer, generating an overview of the community composition of the environmental sample. I found that the abundance of metabo-cally active bacterioplankton correlated positively with water temperature but not with precipitation. Further work is underway to incorporate microbial community composition and additional physical variables into these analyses.

Potential regulation of Synechococcus growth and si-ca content by si-cic acid concentrations in sea water

Hannah C. McDaniel, University of Maine, Orono
Bigelow Mentors: Dr. Benjamin Twining, Ms. Sara Rauschenberg, Dr. Jochen Nuester

The marine cyanobacterium Synechococcus is a small (0.6 to 1.6 μm diameter), coccoid prokaryote with a widespread geographical distribution. Synechococcus has no known si-con requirement, however in pre-minary studies uti-zing synchrotron x-ray fluorescence microscopy, the presence of si-con was detected in Synechococcus cells (Twining et al. unpub-shed). Other non-si-con dependent algae have been found to vary si-ca content based on si-cate availabi-ty. We looked at the

affect varying si-cic acid concentrations in sea water had on Synechococcus growth and si-ca content. Axenic Synechococcus batch cultures were grown in trip-cate under either low (0.1uM), medium (1uM), or high (10uM) si-cic acid concentrations. Three variables; growth rate, si-cate drawdown, and si-ca accumulation, were monitored during the culture experiment. Cell counts were taken every other day using either a Coulter Counter or Epifluorescence microscopy. Reactive si-cate samples were collected every other day and were run at the end of each trail. Particulate Si-ca samples were collected and analyzed at the end of each trial. The si-cic acid concentration of the cultures was found to increase s-ghtly over the course of the trials. Si-cic acid concentration was found to have no affect on Synechococcus growth. Si-ca content of Synechococcus was found to vary with si-cic acid concentration. Synechococcus uptake of si-con seems to be based on availabi-ty with no clear disadvantage or benefit to the cell.

In situ monitoring of tethered lobsters reveals diel shifts in predation intensity and canniba-sm

Noah Oppenheim, Reed College
Bigelow Mentor: Dr. Richard Wahle

Predation is a key ecological process regulating marine benthic communities, however, -ttle is known of how predation rates vary over the day-night cycle. The American lobster is a conspicuous and ecologically important member of the coastal benthic community in the Gulf of Maine. As a mid-trophic level consumer, its role is both predator and prey. Lobster population densities in midcoast Maine are at an all-time high at a time when fish predators are at an all-time low from overharvesting. Previous daytime observations indicate that juvenile lobsters are vulnerable to visual predators, mostly fishes, which are active in the daytime, whereas lobsters are primarily nocturnally active, emerging from shelter to forage at night. Using infrared time-lapse video monitoring and tethering experiments, we observed significant diel differences in predation rates and predator species composition. Predation rates were unexpectedly higher at night and most of the observed predation was by larger lobsters. The results suggest that canniba-sm could be a density-dependent process operating when lobster population densities are high as a consequence of reduced predatory pressure from fishes.