Online Proceedings

SESSION 1D

ECOLOGY AND EVOLUTION

Session Moderator: Bonnie Becker, Interdisciplinary Arts & Sciences (Tacoma Campus)

MGH 234

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

The Genomic Capacity and Physiology of Low-Oxygen Stress on *Prochlorococcus*

Natalie Kellogg, Senior, Oceanography, Biochemistry
Mary Gates Scholar
Mentor: Gabrielle Rocap, Oceanography
Mentor: Anitra Ingalls, Oceanography

Widespread in tropical and subtropical oceans, the marine Cyanobacteria *Prochlorococcus* are the smallest and most abundant photosynthetic organisms on Earth, playing an important role in global primary production. As a collective group, *Prochlorococcus* have a very large pangenome, consisting of a conserved core genome and variant accessory genes. *Prochlorococcus* forms two ecotypes, the low-light (LL) adapted lineages—which possess large amounts of accessory genes—and the more streamlined high-light (HL) adapted lineages. The gain and loss of accessory genes in *Prochlorococcus* reflects their genomic and physiological differences and allows ocean niche differentiation. Recently, uncultivated lineages of LL-adapted *Prochlorococcus* have been identified in oxygen deficient zones (ODZs) that dominate under high-nutrient, low-light, and low-oxygen conditions. In my research, I explored the possibility that LL-adapted ODZ *Prochlorococcus* possess accessory genes related to low-oxygen stress (e.g. redox-sensitive enzymes and redox-dependent metabolic processes such as photosynthetic electron transport and photorespiration) that are likely lost in HL-adapted *Prochlorococcus*. To understand the effects of low-oxygen stress on the LL-adapted Cyanobacteria *Prochlorococcus*, I assessed the genomic potential for low-oxygen genes through computational analysis of a metagenomics dataset capturing native ODZ *Prochlorococcus* as well as the annotated genomes of the LL-adapted cultured isolates MIT9303 and MIT9313. I am currently measuring the physiological response of LL-adapted culture isolate MIT9313 under low oxygen conditions through growth experiments, during which the presence and scope of metabolites showing changes in redox chemistry due to low-oxygen stress will be analyzed using liquid chromatography mass spectrometry. My results will show if LL-IV strains contain low-oxygen accessory genes, and if they combat the negative physiological effects of low O2 concentrations. As ODZs grow the global rising temperatures, knowing how LL-adapted *Prochlorococcus* responds to low-oxygen stress could give insight on how primary production will be affected by a changing ocean.

POSTER SESSION 3

Balcony, Easel 95

2:30 PM to 4:00 PM

Symbiosis in the Ocean Microbiome: Quantified Cobalamin Production among *Ruegeria pomeroyi*, *Sulfitobacter* sp. and their Symbiont *Thalassiosira pseudonana*

Regina Marie (Regina) Lionheart, Senior, Oceanography
Mentor: Katherine Heal, Oceanography
Mentor: Anitra Ingalls, Oceanography

The primary producers of the ocean are responsible for nearly 50% of the carbon fixation on Earth. Many eukaryotic primary producers such as globally important diatoms require Vitamin B_12, also known as cobalamin, as they lack the biosynthetic pathway for the metabolically expensive molecule. A symbiosis between eukaryotic autotrophs and some marine bacteria has been proposed as the source of cobalamin to these B_12-requiring phytoplankton, but the quantitative nature of this relationship is not fully understood. With advancements in analytical techniques in liquid chromatography-mass spectrometry, we can learn more about microbial symbiosis, including vitamin interchange in pelagic microbial communities. This research will investigate the null hypothesis that the mean production of cobalamin of two species of pelagic proteobacteria (*Ruegeria pomeroyi DSS-3* and *Sulfitobacter sp. SA11*) is equal under three different treatments: growth in a limited-carbon environment, growth in an environment enriched with stress molecules from a well-studied model diatom (*Thalassiosira pseudonana*), and growth in media with stressed *T. pseudonana* filtrate added. The alternate hypotheses state that cobalamin output will be affected by these different treatments. Data resulting from the experiments will undergo one-way ANOVA

tests to determine statistical differences between means. With a more complete understanding of how bacteria and eukaryotic autotrophs interact, the possibilities for this field are significantly expanded. Quantifying cobalamin production in marine bacteria on a per-cell basis under varying conditions is a possible benefit of this research, as well as understanding more about the level of control bacteria exert on their symbiosis with eukaryotic autotrophs.