Final Report:

Transport and its regulation in Marine Microorganisms: A Genomic Based Approach

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Executive Summary

This grant funded the analysis and annotation of the genomes of *Synechococcus* and *Ostreococcus*, major marine primary producers. Particular attention was paid to the analysis of transporters using state of the art bioinformatics analyses. During the analysis of the *Synechococcus* genome, some of the components of the unique bacterial swimming apparatus of one species of *Synechococcus* (*Clade III, strain WH8102*) were determined and these included transporters, novel giant proteins and glycosyltransferases. This grant funded the analysis of gene expression in *Synechococcus* using whole genome microarrays. These analyses revealed the strategies by which marine cyanobacteria respond to environmental conditions such as the absence of phosphorus, a common limiting nutrient, and the interaction of *Synechococcus* with other microbes. These analyses will help develop models of gene regulation in cyanobacteria and thus help predict their responses to changes in environmental conditions.

Project Results

The strikingly high abundance of cyanobacteria in marine waters was discovered only in 1979 and subsequent studies documented the importance of marine *Synechococcus* to primary productivity and their near global distribution. Although considered ecologically as one functional group, it soon became apparent that *Synechococcus* has significant genetic diversity as seen in %GC studies and in some phenotypic characteristics. Molecular sequence evidence from field samples showed the presence of distinct genetic clusters and that these sometimes had distinct distributions in the water column suggesting distinct species with different ecological niches. Similarly, small picoeukaryotes such as *Ostreococcus* have recently been discovered and their importance to primary production realized.

This grant funded the analysis and annotation of the genomes of *Synechococcus* and *Ostreococcus*. Particular attention was paid to the analysis of transporters using state of the art bioinformatics analyses. Transporters help the cell bring in nutrients such as nitrogen, phosphorus and trace metals that fuel primary productivity. In addition some transporters have other roles such as moving proteins across cell membranes or exporting toxins. During the analysis of the *Synechococcus* genome, some of the components of the unique bacterial swimming apparatus of one species of *Synechococcus* (*Clade III, strain WH8102*) were determined and these included transporters, a novel giant protein, and glycosyltransferases.

This DOE grant funded the analysis of gene expression in *Synechococcus* using whole genome microarrays. These analyses revealed the strategies by which marine cyanobacteria respond to environmental conditions such as the absence of phosphorus, a common limiting nutrient, and the interaction of *Synechococcus* with other microbes. Grant funds were used as proposed and included additional work on *Ostreococcus* as this genome was just becoming available through DOE funding.

The grant helped fund the training and research of three graduate students, Jay McCarren and Vera Tai and Chris Dupont.

Publications funded and acknowledged by this grant are listed below. These contain the detailed technical findings of this grant. Funds helped make transporter analyses available publicly at <http://www.membranetransport.org/index.html>.

Publications

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Synechococcus Strain Journal of Bacteriology 187: 224-230.
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