Evolution and diversity of novel marine nitrogen-fixing organisms and their impact on global climate

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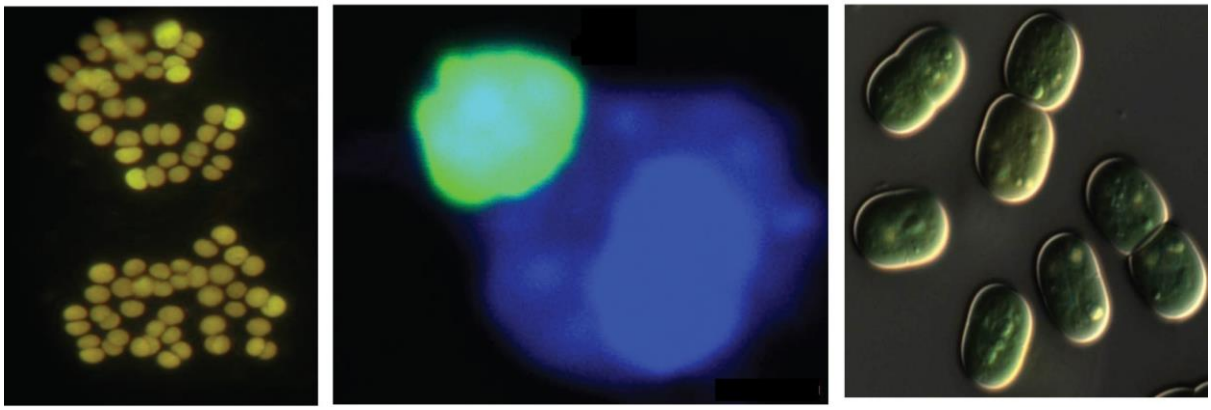
Project description:



Scientific Background and Significance:
Ocean phytoplankton are key in regulating the state of marine ecosystem and climate. Particularly important are phytoplankton which can fix atmospheric N2 into a bio-available source of nitrogen such as ammonium. Because nitrogen is the dominant limiting nutrient in the ocean, nitrogen fixers are crucial in supporting marine productivity and thus regulating our climate via the uptake and sequestration of atmospheric CO2. Within this key phytoplanktonic group, new symbiotic species have been discovered recently [Bombar et al., 2014]. Interestingly these novel micro-organisms have undergone genome reduction as a result of establishing symbiotic associations with unicellular algae hosts. A trend in genome reduction likely reflects adaptation of the host to grow in nutrient-poor environments such as the mid-ocean gyres, which are geographically dominant. These findings offer an exciting opportunity to study the evolution of nitrogen fixers and their impact on past and present marine life, global nutrient cycles and climate.

Research Methods and Student's Role:
This project aims to study the genomic differences between newly discovered nitrogen fixers and their closest relatives, and how these differences are reflected into their ecological niches (e.g., coastal versus open ocean). The student will mainly employ comparative analyses using genomic data to determine how genetic differences (e.g., gene structure, gene content) relate to ecological differences, geographical distribution and past climatic events. The student will also have the opportunity to use the successful MIT-Darwin ocean model [Monteiro et al., 2010] to investigate the diversity and importance of these novel organisms to fuelling life in the ocean. This exciting project is particularly inter-disciplinary, and is a great opportunity for students interested in marine biology, evolution and climate.

References:
[1] Bombar, D., P. Heller, P. Sánchez-Baracaldo, B. J. Carter and J. P. Zehr. (2014) Comparative genomics reveal surprising

divergence of two closely related strains of uncultivated UCYN-A cyanobacteria. The ISME Journal. doi: 10.1038/ismej.2014.167
[2] Monteiro, F. M., Follows, M. J., & Dutkiewicz, S. (2010). Distribution of diverse nitrogen fixers in the global ocean. Global
Biogeochemical Cycles, 24(3), GB3017. doi:10.1029/2009GB003731