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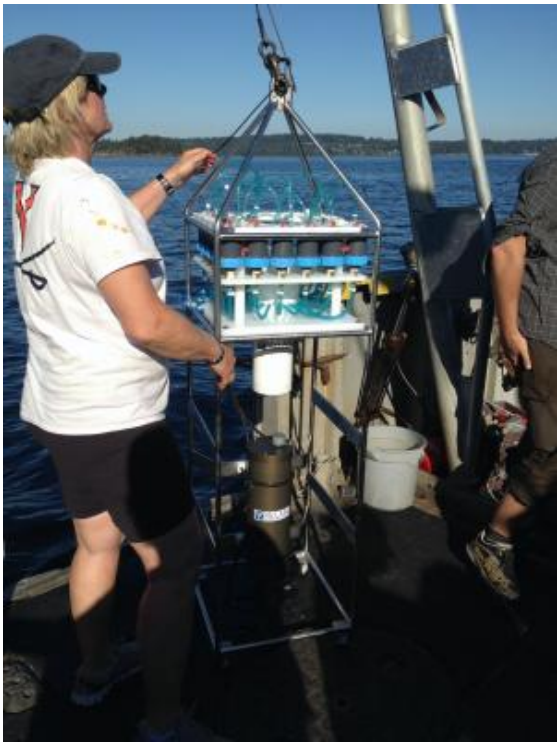
Edgcomb Laboratory: Anoxic Water Column Protists

The concentration of dissolved oxygen (O_2) in the ocean determines the structure and function of marine ecosystems. Loss of dissolved oxygen in the ocean favors chemolithoautotrophic metabolism that causes a decrease in nitrogen and production of the greenhouse gases nitrous oxide (N_2O) and methane (CH_4). Protists are important members of aquatic microbial communities. Through grazing on prokaryotic and other eukaryotic prey, they modify or remineralize organic matter and regenerate nutrients. They also can affect the quantity, activity and physiological state of their prey. Thus, through direct and indirect effects, protists help determine the metabolic potential of microbial communities. Bacterial grazing in marine environments is principally performed by flagellated protists and ciliates. We are interested in looking at the diversity and role of protists in low oxygen to sulfidic marine water columns. Our current study sites include the Eastern Mediterranean deep hypersaline anoxic basins, the Cariaco Basin, Venezuela, and Saanich Inlet.

Saanich Inlet is a seasonally anoxic fjord and an example of a marine oxygen minimum zone (OMZ). OMZs are becoming areas of growing interest for several reasons. First, studies have indicated that climate change induced formation and intensification of OMZs is increasing worldwide. Second, OMZs influence carbon sequestration and cycling as well as the cycling of nitrogen in the world's oceans. OMZs support enigmatic communities of microorganisms that regulate global cycles of nutrients and gases. Together with our collaborators we are examining the response in microbial eukaryotes (protists) to changing oxygen concentrations using 18S small subunit ribosomal RNA (SSU rRNA) and metatranscriptomic, as well as microscopy-based approaches. OMZs and permanently anoxic water columns select for unique assemblages of protists, including many novel lineages.

The Cariaco Basin is a classic example of the anoxic end-member, off the northern coast of Venezuela. With collaborators G. Taylor (Stony Brook U.), C. Taylor (WHOI), and W. Betancourt (IVIC, Venezuela), we have a NSF project grant (Biological Oceanography) "Collaborative Research: Genetic and Metabolic Signatures of Marine Microorganisms in Oxygen Depleted and Varying Geochemical Seascapes (MetaOmics in the Cariaco Basin)." This project integrates hydrographic, geochemical and microbial ecological data with metagenomic and metatranscriptomic profiles to understand regulatory and metabolic networks defining microbial community responses to environmental forcing during high and low productivity periods. This will help us to understand the importance of processes, such as anaerobic oxidation of methane, utilization of redox-sensitive metals, the cryptic sulfur cycle in this oxygen-depleted water column, and the impacts of oxygen depletion on nitrogen transformations. It will help us to determine the importance of associations between microbial eukaryotes and prokaryotes there, and to identify 'indicator' genes of known or unknown function that may be relevant to major elemental and trace gas cycling as targets for further biochemical characterization and molecular probe development, and to quantify a key subset of these genes and transcripts across redox gradients using qPCR. The data will provide a basis for developing monitoring tools using expressed genes indicative of important elemental transformations and fluxes, e.g., denitrification, anammox, sulfur oxidation, methanogenesis/trophy, for diagnosing the health status of natural and human engineered ecosystems. Our results will be compared with recent and ongoing studies of other oxygen-depleted water columns to discern shared and unique attributes of these systems.



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Saanich Inlet with S. Crowe and S. Hallam and SCOR Working Group

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Elizabeth Suter (Stony Brook University), Maria Pachiadaki (WHOI) and Craig Taylor (WHOI) on the R/V *Hermano Gines*, Cariaco Basin

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Liz Suter (Stony Brook University), Cariaco Basin 2014

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Gordon Taylor (Stony Brook University) and Enrique Montes Herrera (U. Southern Florida), Cariaco Basin

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Research in Cariaco Basin

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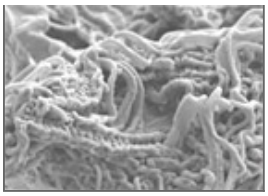
Maria Pachiadaki and Craig Taylor program the IPS Sampler prior to deployment

Multimedia

Movie of representative cell of novel ciliate class CARH

Credit: William Orsi



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