Plan Overview

A Data Management Plan created using DMPTool

Title: Contribution and Significance of Osmotrophy in Phytoplankton Carbon Biomass Productivity

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Template: NSF-BIO: Biological Sciences

Project abstract:

Algae or phytoplankton have long been associated with converting light energy into organic matter through photosynthesis. This conventional notion of phytoplankton as phototrophs can be challenged as evidence from studies conducted since the 1960s indicates the existence of heterotrophy and mixotrophy metabolisms in phytoplankton. Mixotrophy in phytoplankton involves two heterotrophic processes along with phototrophy—phagotrophy and osmotrophy—with varying utilization depending on the species. This proposal will specifically focus on osmotrophy in phytoplankton. Understanding a surface ocean ecosystem's trophic mode—net phototrophic v. net heterotrophic—is essential to better comprehend carbon cycling, yet most datasets fail to examine the phytoplankton phototrophy/mixotrophy balance. Our preliminary data shows nearly 2–3-fold growth rate increase in certain species in response to organic carbon additions. Moreover, a recent study (Balch et al., 2022) unveiled a shift in phytoplankton composition in the Gulf of Maine from primarily photosynthetic coccolithophores to primarily mixotrophic dinoflagellates, thus highlighting the importance of mixotrophy. Assuming minimal respiration accounting for 10% of total gross photosynthesis under a complete autotrophic scenario, a 2–3-fold growth rate increase under mixotrophic conditions would bring respiration rates higher than photosynthesis, i.e., to net heterotrophy. This shift indicates the potential for the overall metabolic status of a given ecosystem to change from net phototrophic to heterotrophic. Our main objective will be to quantify the contribution of osmotrophy v. photosynthesis to phytoplankton carbon biomass productivity based on the following hypotheses: (1) The osmotrophy contribution to phytoplankton carbon biomass is higher for coastal ocean phytoplankton species than for open ocean species. (2) The osmotrophy and phototrophy contributions to phytoplankton carbon biomass productivity depend on DOC concentrations and light levels. A more pronounced osmotrophy contribution will be observed in waters with higher DOC concentrations such as coastal ecosystems and lower light levels (net heterotrophic system) relative to waters with lower DOC concentrations such as oceanic systems and higher light levels (phototrophic system). (3) Spectral absorption coefficients and chlorophyll a concentrations will increase under osmotrophy, leading to decreased primary productivity as estimated by models.

Start date: 07-01-2024

End date: 06-30-2027

Last modified: 12-10-2023

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Question not answered.

All our data will be submitted as a clean matrix and will be stored in a comma separated files (.csv) with an associated metadata file. The biological and ecological data will be structured in Ecological Metadata Language (EML). We will also include a “readme file” that will explain variables, structure of the files, etc. for each of the independent data sets.

All personnel funded through this project will be responsible for maintaining and updating individual data sets and for writing detailed metadata and read me files that outline all components of how, when and where a particular data set was collected. Lead PI Kamalanathan and co-PI Mitchell will be responsible for responsible overseeing the overall post-processing and QA/QC needed to prepare the dataset for its deposition into a repository. A fraction of their salaries requested will be used for data management activities, in particular data entry, QA/QC, calibration, metadata management, and conversion to standard formats.

Data and metadata will be submitted to the Biological and Chemical Oceanography Data Management Office (BCO-DMO). 16s and 18s data from this project will be submitted to the National Center for Biotechnology Information (NCBI) GenBank repository as recommended by BCO-DMO. Sharing our data and results will be through DOIs at the data repository and journal publications and conference presentations. Data will be fully downloadable within two years of collection and/or after publication of the results. In addition to sharing data, all code created to analyze the data will be made publicly available through GitHub. Final, quality-checked, downloadable data and metadata will be freely accessible to anyone who is interested via publicly accessible repositories (e.g., BCO-DMO).

Final, quality-checked, downloadable data and metadata will be freely accessible to anyone who is interested via publicly accessible repositories (e.g., BCO-DMO). As outlined in the above, data from this project will be made freely available to the public through open-source repositories. Due to the nature of the analyses proposed, most of the physical samples will be destroyed during analysis but those not destroyed during analysis will be archived at Bigelow Laboratory. We do not anticipate any financial benefit from the intellectual property generated from this work. Authorship of publications will be determined based on the concept of the manuscript, origin of the samples and level participation in acquisition and analysis. The PIs of this proposal agree that all PIs will be included on papers addressing the core hypotheses and objectives of the proposed work.

Many of our sampling and analytical activities are destructive, preventing archiving of many of our samples. DNA samples will be stored in Kamalanathan’s labs. All information related to initial data collection, analysis, and results will be recorded in a laboratory notebook. Paper notebooks will be retained and archived in a retrievable way. All research notebooks of individual researchers will be the property of Bigelow. We plan to keep a copy of all the data and associated materials for 10 years past the lifetime of the project. This long-term preservation will be accomplished by keeping several copies of the data in the institutional cloud storage area (Google Drive) and physical backup system.