Cell volumes were calculated for 8 species of marine cryptophytes grown under full-spectrum, blue, green, or red light during laboratory-based growth experiments in 2018

Website: https://www.bco-dmo.org/dataset/870161
Data Type: experimental
Version: 1
Version Date: 2022-02-22

Project
» Dimensions: Links Between Spectral Irradiance and Cryptophyte Biodiversity in Environments from Ponds to Oceans (Spectral Irradiance and Cryptophyte Biodiversity)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
Richardson, Tammi	University of South Carolina	Principal Investigator
Dudycha, Jeffry L.	University of South Carolina	Co-Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Cell volumes were calculated for 8 species of marine cryptophytes grown under full-spectrum, blue, green, or red light during laboratory-based growth experiments conducted in February of 2018.

Table of Contents

Coverage

Temporal Extent: 2018-02-01 - 2018-02-12

Methods & Sampling

Full details are available in Heidenreich & Richardson (2020).

Cell volumes were calculated using a Nikon Eclipse TS100 inverted microscope at 200x magnification using live cells that were left on the stage for a period of time to slow their swimming speed.

Cell sizes were performed using non-preserved cells. We found that preserving these cryptophytes caused them to shrink or swell; response was unpredictable among species.

We assumed the shape was a prolate spheroid; where V = pi/6 * Length * width^2

Light treatments (all with 30 umol m^-2 s^-1 light intensity):

Full = Full Spectrum
Blue = Blue only
Green = Green only
Red = Red only

Each row in the data table corresponds to measurements from one cell within one of the light treatments.

Species List:

ScientificName,Strain,AphiaID,LSID
Chroomonas mesostigmatica, CCMP 1168,573826,urn:lsid:marinespecies.org:taxname:573826
Guillardia theta, CCMP 327,590566,urn:lsid:marinespecies.org:taxname:590566
Hemiselmis andersenii, CCMP 644,623449,urn:lsid:marinespecies.org:taxname:623449
Hemiselmis cryptochromatica, CCMP 1181,623450,urn:lsid:marinespecies.org:taxname:623450
Hemiselmis tepida, CCMP 443,623452,urn:lsid:marinespecies.org:taxname:623452
Proteomonas sulcata, CCMP 1175,573956,urn:lsid:marinespecies.org:taxname:573956
Rhodomonas salina, CCMP 1319,106316,urn:lsid:marinespecies.org:taxname:106316
Storeatula sp., CCMP 1868,573984,urn:lsid:marinespecies.org:taxname:573984

Data Processing Description

Infinity Analyze program (V6.5.4; Lumenera Corporation, Nepean, Ontario, Canada).

BCO-DMO Data Manager Processing Notes:
* Data from 8 Excel source files (one file per strain) Sheet1 were imported into the BCO-DMO data system. Original sheets had 4 data tables per sheet (one per light treatment).
* Strategy for formatting data developed with the data submitter.
* The separate strain and light treatment tables were concatenated into one data table with added columns to capture Treatment (Full, Red, Green, Blue), Replicate (within treatment) and what strain the treatment was for. Each row in the table corresponds to measurements from one cell.
* Parameters (column names) renamed to comply with BCO-DMO naming conventions. See https://www.bco-dmo.org/page/bco-dmo-data-processing-conventions
* Date column added from metadata preceding each table in the excel file (added in ISO 8601 format YYYY-MM-DD)

* Species names checked using the World Register of Marine Species taxa match tool. All names matched exactly to a currently accepted name (as of 2022-02-22). Species list, strain name, LSID and AphiaID added to metadata text.
* Data table sorted by {Date}{Species}{Strain}{Treatment}{Replicate}

[table of contents | back to top]

Data Files

File
crypto_cell_volumes.csv (Comma Separated Values (.csv), 401.79 KB) MD5:36522c25b8afb1d6d577ac52808835e9 Primary data file for dataset ID 870161

[table of contents | back to top]

Related Publications

Heidenreich, K. M., & Richardson, T. L. (2020). Photopigment, Absorption, and Growth Responses of Marine Cryptophytes to Varying Spectral Irradiance. Journal of Phycology, 56(2), 507–520. Portico. https://doi.org/10.1111/jpy.12962
General

Teledyne Lumenera (2022). INFINITY ANALYZE and CAPTURE for Windows. Available at https://www.lumenera.com/infinity-analyze-and-capture-for-windows.html
Software

[table of contents | back to top]

Parameters

Parameter	Description	Units
Date	Cell measurement date in ISO8601 format YYYY-MM-DD	unitless
Species	Scientific name (Genus species) of the cell measured	unitless
Strain	Strain of the cell measured (e.g. CCMP 1168)	unitless
Treatment	Light treatment (Full = Full Spectrum; Blue = Blue only; Green = Green only; Red = Red only). See methodology.	unitless
Replicate	Replicate number for each strain and treatment (unique for strain and light treatment).	unitless
Length	Cell length (longest axis)	micrometers (um)
Width	Cell width (shortest axis)	micrometers (um)
Volume	Cell volume (calculated, see methodology)	cubic micrometers (um^3)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Nikon Eclipse TS100
Generic Instrument Name	Inverted Microscope
Dataset-specific Description	Cell sizes performed on Nikon Eclipse TS100 inverted microscope at 200x magnification using non-preserved cells.
Generic Instrument Description	An inverted microscope is a microscope with its light source and condenser on the top, above the stage pointing down, while the objectives and turret are below the stage pointing up. It was invented in 1850 by J. Lawrence Smith, a faculty member of Tulane University (then named the Medical College of Louisiana). Inverted microscopes are useful for observing living cells or organisms at the bottom of a large container (e.g. a tissue culture flask) under more natural conditions than on a glass slide, as is the case with a conventional microscope. Inverted microscopes are also used in micromanipulation applications where space above the specimen is required for manipulator mechanisms and the microtools they hold, and in metallurgical applications where polished samples can be placed on top of the stage and viewed from underneath using reflecting objectives. The stage on an inverted microscope is usually fixed, and focus is adjusted by moving the objective lens along a vertical axis to bring it closer to or further from the specimen. The focus mechanism typically has a dual concentric knob for coarse and fine adjustment. Depending on the size of the microscope, four to six objective lenses of different magnifications may be fitted to a rotating turret known as a nosepiece. These microscopes may also be fitted with accessories for fitting still and video cameras, fluorescence illumination, confocal scanning and many other applications.

[table of contents | back to top]

Project Information

Dimensions: Links Between Spectral Irradiance and Cryptophyte Biodiversity in Environments from Ponds to Oceans (Spectral Irradiance and Cryptophyte Biodiversity)

Coverage: Ponds, lakes, estuaries and oceans globally

In aquatic environments, microscopic algae known as phytoplankton are important primary producers. Through photosynthesis, these organisms fix carbon dioxide into the organic carbon molecules that fuel life in ponds, rivers, lakes and oceans. The color of light available for photosynthesis varies among environments, e.g., the deep blue ocean vs. a black water river. In order to live in a particular environment, phytoplankton must have photosynthetic pigments that are tuned to absorbing the colors of light available. This project focuses on the cryptophytes, a relatively uncharacterized group of phytoplankton, that are abundant in a wide range of aquatic habitats ranging from small ponds to oceans. Cryptophytes use phycobilin pigments to capture light energy; these pigments allow cryptophytes to photosynthesize in light environments that are poorly exploited by other types of algae. The project goals are: (1) to characterize the ecological distribution and taxonomic diversification of cryptophyte species, (2) to determine the effectiveness of their light capture in different light environments, and (3) to characterize the molecular evolutionary pathways of critical light capture genes. Understanding these links is important to predicting how changes in land-use (like deforestation and urbanization, both of which impact the color of light in downstream watersheds) will affect aquatic productivity. This project will provide training for a post-doc, 2-4 graduate students, and 10 undergraduates. Through a partnership with Morris College and other University of South Carolina programs, underrepresented minorities will be recruited into summer fellowships. Novel cryptophyte strains will be deposited in living culture collections for use by other researchers.

This project's central question is deceptively simple: How do functional, genetic, and phylogenetic diversity interact in the ecological diversification of cryptophytes with respect to light environment? The researchers will conduct an integrative research program on the biodiversity of cryptophytes to understand how

environmental variation in spectral irradiance is associated with the physiological diversity of light capture in cryptophytes in the context of their historical diversification. This work integrates several components: (1) Field sampling in water bodies ranging from small ponds to oceans to identify the specific light environments in which strains live, to determine the pigments that cryptophytes produce in those habitats, and to identify novel species; (2) Phenotypic studies to determine how variation in spectral irradiance (light color) influences light capture, photosynthesis, and growth of diverse taxa. These will also determine spectral absorption of phycobilins in strains throughout the cryptophyta; (3) Construction of a well-supported phylogeny based on sequencing nucleomorph genomes of ~200 strains; (4) Analyses of molecular evolution of key light capture genes, in particular those that encode the alpha and beta subunits of the cryptophyte phycobiliproteins, and those involved in the phycobilin synthesis pathway; (5) Experimental evolution to test the ability of diverse strains of cryptophytes to evolve into new light niches; (6) Experimental transcriptomics to identify the functional responses of diverse strains to variation in spectral irradiance; and (7) Phylogenetically-informed tests of the associations between habitat, molecular evolution, organismal performance, and spectral absorbance. Ultimately, this work should be a transformative contribution to our understanding of the diversification of photosynthesis and the role of that diversification in the ecological distribution of cryptophytes.

[table of contents | back to top]

Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Environmental Biology (NSF DEB)	DEB-1542555

[table of contents | back to top]