Photophysiological responses of two dinoflagellate species used in natural high light exposure experiments (Protist Signaling project)

Website: https://www.bco-dmo.org/dataset/723266
Data Type: experimental
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Project
» Environmental stress and signaling based on reactive oxygen species among planktonic protists (Protist signaling)

Contributors	Affiliation	Role
Strom, Suzanne	Western Washington University - Shannon Point Marine Center (SPMC)	Principal Investigator
Ake, Hannah	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Photophysiological responses of two dinoflagellate species used in natural high light exposure experiments (Protist Signaling project)

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Coverage

Temporal Extent: 2015-07-15 - 2015-09-10

Dataset Description

Photophysiological responses of two dinoflagellate species used in natural high light exposure experiments.

Methods & Sampling

Irradiance exposure experiments: Experiments to test the light stress response consisted of exposing dinoflagellates to natural sunlight and monitoring a range of physiological and biochemical responses. Sunlight exposure took place in unshaded outdoor Plexiglas tanks (without lids), supplied with a constant flow of seawater to maintain incubation bottles approximate growth temperatures of 15-16°C for the duration of each experimental exposure period. A Li-Cor LI-1400 data logger with a 2π sensor collected incident PAR data; irradiance received during incubation period is presented as total dose (mol photons m-2) and (for Fv/Fm data) as the maximum instantaneous irradiance recorded during the exposure period (µmol photons m-2 s-1). To initiate experiments, dinoflagellate cultures were combined and divided into 250-mL polycarbonate bottles,

which block penetration of UVR. Bottles were returned to the growth incubator for approximately 1 h acclimation before the experiment began. After acclimation, “pre-exposure” samples were collected from each bottle for determination of morphological, biochemical, and physiological characteristics of dinoflagellate cells. Bottles were then covered in treatment-specific neutral density screening as needed to achieve desired irradiances, and placed in the outdoor tank to begin the light exposure period. Control bottles were covered with enough screen layers to approximate growth incubator irradiances. Experiments included four replicates each of either two or three treatments: all experiments included “high PAR” and “control” treatments, while A2 and H2 also included “moderate PAR”. Exposure duration varied slightly by experiment but was approximately 1.5 h. Photosynthetic efficiency Fv/Fm (unitless) was measured at 15, 25, or 30 min time intervals during the exposure period, depending on the experiment. After the exposure period, all bottles were taken indoors for a second round of sampling (henceforth referred to as “post-exposure”). Bottles were then rid of any screening and returned to the growth incubator for the recovery period (1.5-2 h depending on experiment). After recovery a third round of samples (termed “post-recovery”) was collected.

Photosynthetic efficiency Fv/Fm: Samples (2 mL) were taken from each bottle at regular intervals (see above) during the light treatment exposure and subsequent recovery period; samples were then dark-incubated at 15°C for 20 min. After dark acclimation, Fv/Fm was measured using a Walz Water-PAM pulse amplitude-modulated fluorometer.

Data Processing Description

BCO-DMO Data Processing Notes:

- reformatted column names to comply with BCO-DMO standards
- replaced all blank cells with nd
- reformatted data into long format instead of wide
- date reformatted to yyyy/mm/dd
- spaces replaced with underscores

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Data Files

File
fvfm.csv (Comma Separated Values (.csv), 46.13 KB) MD5:46e68810914e882362f987d3a8e5c6b9 Primary data file for dataset ID 723266

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Related Publications

Cooney, E. C. “The Effect of High-Intensity Visible Light on the Bloom Niches of the Phototrophic Dinoflagellates Alexandrium Fundyense and Heterocapsa Rotundata.” WWU Masters Thesis Collection, Western Washington University, Western Washington University, 2016, cedar.wwu.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1534&context=wwuet. https://cedar.wwu.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1534&context=wwuet
Related Research

Cooney, E. C., Fredrickson, K. A., Bright, K. J., & Strom, S. L. (2019). Contrasting effects of high-intensity photosynthetically active radiation on two bloom-forming dinoflagellates. Journal of Phycology, 55(5), 1082–1095. Portico. https://doi.org/10.1111/jpy.12890
Methods

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Parameters

Parameter	Description	Units
Experiment_ID	Experiment ID number	unitless
Experiment_Date	Experiment date; YYYY/MM/DD	unitless
Dinoflagellate_species	Species of sample	unitless
Max_PAR	Maximum instantaneous PAR received during light exposure treatment	umol photons m^-2 s^-1
Total_PAR	Total dose of photosynthetically active radiation received during lightexposure treatment	mol photons m^-2
Sampling_Time	Time of sampling; HH:MM	unitless
Treatment	Treatment	unitless
Sample_Number	Sample ID Number	unitless
FvFm	Photosynthetic efficiency (variable fluorescence normalized to maximum fluorescence)	unitless
ISO_DateTime_UTC	DateTime ISO Formatted; UTC	unitless

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Instruments

Dataset-specific Instrument Name	Walz Water-PAM pulse amplitude-modulated fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used to measure FvFm
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Li-Cor LI-1400 data logger with a 2π sensor
Generic Instrument Name	LI-COR LI-1000 Data Logger
Dataset-specific Description	Used to collect PAR data
Generic Instrument Description	"The LI-1000 DataLogger is a 10 channel datalogger that functions both as a data logging device and a multichannel, autoranging meter. The electronics of the LI-1000 have been optimized for highly accurate measurement of LI-COR radiation sensors which have a current signal" (from LI-COR Datalogging Instruction Manual, p 1). LI-COR began manufacturing these instruments in 1985 and discontinued in 1998. Serial Numbers for this model have the prefix of LDL-XXXX. (www.licor.com)

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Deployments

Strom_2014

Website	https://www.bco-dmo.org/deployment/684891
Platform	lab Strom
Start Date	2014-09-01
End Date	2017-08-01
Description	Five strains of coccolithophore Emiliania huxleyi were grown in the lab. Originally collected from the Salish Sea: 48.5, -122.75.

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Project Information

Environmental stress and signaling based on reactive oxygen species among planktonic protists (Protist signaling)

Coverage: Salish Sea: 48.5, -122.75

Description from NSF proposal:
This proposal arises from the central premise that the oxidative stress response is an emergent property of phototrophic cellular systems, with implications for nearly every aspect of a phytoplankton cell's life in the upper ocean. Oxidative stress (OS) arises from the uncompensated production of reactive oxygen species (ROS) within a cell, which can occur in response to a myriad of environmental stressors (e.g. nutrient limitation, temperature extremes, toxins, variable light exposure). In addition to the biochemical damage and physiological impairment that OS can cause, the phytoplankton OS response also includes increased net production and extracellular release of ROS, osmolytes, and other compounds that are known or suspected to be potent signals regulating protist behavior. We hypothesize that, through chemical signaling, oxidative stress acts to govern relationships among environmental variability, phytoplankton condition, and protist predation. Our proposed study of these integrated signaling and response processes has three overarching objectives: 1) Create and characterize oxidatively stressed phytoplankton. We will use light stress (variable exposure to visible light and UV) to create oxidatively stressed phytoplankton in the laboratory. Common coastal taxa with contrasting stress responses will be characterized using an array of fluorescent probes, biochemical

measurements, and physiological assays. In addition, intracellular production and extracellular release of ROS and the associated chemical signal DMSP will be quantified. Use of *Phaeodactylum tricornutum* light stress mutants will add an independent means of connecting OS to signal production and predation response. 2) Examine protist predator responses to oxidatively stressed phytoplankton and associated chemical signals. Responses will be investigated by means of manipulation experiments and thorough characterization of associated signal chemistry. Assessment of predator response will be via predation rate measurements and population aggregation/dispersal behaviors in structured columns. 3) Investigate the prevalence of OS, its environmental correlates, and the microzooplankton predation response in the natural waters of a well-characterized local embayment. Application of ROS probes and OS assays to the natural environment and the design of OS manipulation experiments will be informed by the laboratory experiments using local protist species.

Our work will help to elucidate some of the multiple ways in which the OS response can affect phytoplankton fitness, contributing information that can be used to characterize the position of key coastal species along an OS response spectrum. Ultimately such information could be used in trait-based conceptual and numerical models in a manner analogous to cell size and other 'master traits'. Our research will also inform the relatively new and exciting field of chemical signaling in planktonic communities, exploring DMSP- and ROS-based signaling between two of the most significant groups in the plankton, the eukaryotic phytoplankton and their protist predators. Finally, findings will help elucidate the links between environmental stress, phytoplankton response, and predation in planktonic ecosystems. These links relate to central issues in biological oceanography, including the predator-prey interactions that influence bloom demise, and the mechanisms by which protists feed selectively and thereby structure prey communities. The proposed research is a cross-cutting endeavor that unites subjects usually studied in isolation through a novel conceptual framework. Thus the findings have the potential to generate broadly applicable new insights into the ecological and evolutionary regulation of this key trophic link in planktonic food webs.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1434842

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