Series 1A: Two-stressor effects on Tp-1335: Experiments to investigate the combined effect of light and temperature changes on the growth rate of Thalassiosira pseudonana CCMP

Website: https://www.bco-dmo.org/dataset/714528
Data Type: experimental
Version: 1
Version Date: 2017-09-11

Project
» Collaborative Research: Effects of multiple stressors on Marine Phytoplankton (Stressors on Marine Phytoplankton)

Contributors	Affiliation	Role
Passow, Uta	University of California-Santa Barbara (UCSB-MSI)	Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Series 1A: Two-stressor effects on Tp-1335: Experiments were conducted to investigate the combined effect of light and temperature changes on the growth rate (mu) of Thalassiosira pseudonana CCMP 1335. This is the first series, consisting of 5 experiments

Table of Contents

Coverage

Temporal Extent: 2016-04-15

Dataset Description

Experiments were conducted to investigate the combined effect of light and temperature changes on the growth rate (mu) of *Thalassiosira pseudonana* CCMP 1335. *T. pseudonana* was grown in artificial seawater (ASW) (Kester et al.1967), enriched as in f/2 (Guillard 1975). Each of five experiments per series was conducted at a different temperature (13.4; 18.5; 24.4; 26.5; 22.5 C). At each temperature, cultures were kept on a 12-hour light 12-hour dark cycle under eight light intensities ranging from 35 umol/m^2/S to 140 umol/m^2/s. Optical density measurements (OD680 and OD720), dark-adapted Instantaneous Chlorophyll Fluorescence (F0) and the quantum yield (QY=Fv/Fm, where Fv is the maximal variable fluorescence and Fm is the maximal fluorescence intensity) and cell concentrations were determined daily at the end of the dark period. Cell counts were conducted in a hemocytometer on a microscope.

Date	Expt#	Temperature (°C)
04/15/2016	1	13.4
05/30/2016	2	18.5
07/31/2016	3	24.4
08/20/2016	4	26.5
08/22/2016	5	22.5

Methods & Sampling

Problem Report:
Follow-up experiments indicated that growth rates during these experiments were not maximum for the respective temperature and irradiance conditions. The most likely explanation is growth limitation due to some trace element not present in artificial seawater (ASW). Whereas this species originally grew well in ASW, growth rates dropped under all environmental conditions after several weeks. Experiments were repeated in Series 1B, and cultures grown in ASW with 5% UV-sterilized seawater added.

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- replaced blank cells with 'nd' (no data)

[table of contents | back to top]

Data Files

File
Thal_pseudonana_growth_series1.csv (Comma Separated Values (.csv), 13.63 KB) MD5:19bb696950c6c68533c8dc2fc01a5a8f Primary data file for dataset ID 714528

[table of contents | back to top]

Parameters

Parameter	Description	Units
expt	experiment identifier	unitless
date_local	date of experiment (local time)	unitless
temperature	temperature of culture	degrees Celsius
Light	irradiance: L1=35 µmol m-2 s-1; L2= 50 µmol m-2 s-1; L3=65 µmol m-2 s-1; L4=80 µmol m-2 s-1; L5=95 µmol m-2 s-1; L6=110 µmol m-2 s-1; L7=125 µmol m-2 s-1; L8=140 µmol m-2 s-1	micromole quanta /meter^2/second
Day	day of incubation	days
OD680_avg	optical density at 680 nm; averaged from 7 measurements taken automatically in 10 minute intervals.	unitless
OD720_avg	optical density at 720 nm; averaged from 7 measurements taken automatically in 10 minute intervals.	unitless
F0	instantaneous chlorophyll fluorescence (F_0)	relative units
count_cells_ml	cell concentrations	cells per milliliter
QY	QY=F_v/F_m where F_v is the maximal variable fluorescence and F_m is the maximal fluorescence intensity	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Multicultivator MC-1000 OD (Qubit Systems)
Generic Instrument Name	Cell Cultivator
Dataset-specific Description	Used for incubations and optical density measurements.
Generic Instrument Description	An instrument used for the purpose of culturing small cells such as algae or bacteria. May provide temperature and light control and bubbled gas introduction.

Dataset-specific Instrument Name	Z985 Cuvette Aquapen (Qubit Systems)
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used to measure instantaneous chlorophyll fluorescence (F0) and quantum Yield (QY=Fv/Fm, where Fv is the maximal variable fluorescence and Fm is the maximal fluorescence intensity). A 20-minute dark adaptation time was used. AquaPen settings: f = 30, F=71, A = 50.
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.

[table of contents | back to top]

Project Information

Collaborative Research: Effects of multiple stressors on Marine Phytoplankton (Stressors on Marine Phytoplankton)

The overarching goal of this project is to develop a framework for understanding the response of phytoplankton to multiple environmental stresses. Marine phytoplankton, which are tiny algae, produce as much oxygen as terrestrial plants and provide food, directly or indirectly, to all marine animals. Their productivity is thus important both for global elemental cycles of oxygen and carbon, as well as for the productivity of the ocean. Globally the productivity of marine phytoplankton appears to be changing, but while we have some understanding of the response of phytoplankton to shifts in one environmental parameter at a time, like temperature, there is very little knowledge of their response to simultaneous changes in several parameters. Increased atmospheric carbon dioxide concentrations result in both ocean acidification and increased surface water temperatures. The latter in turn leads to greater ocean stratification and associated changes in light exposure and nutrient availability for the plankton. Recently it has become apparent that the response of phytoplankton to simultaneous changes in these growth parameters is not additive. For example, the effect of ocean acidification may be severe at one temperature-light combination and negligible at another. The researchers of this project will carry out experiments that will provide a theoretical understanding of the relevant interactions so that the impact of climate change on marine phytoplankton can be predicted in an informed way. This project will engage high schools students through training of a teacher and the development of a teaching unit. Undergraduate and graduate students will work directly on the research. A cartoon journalist will create a cartoon story on the research results to translate the findings to a broader general public audience.

Each phytoplankton species has the capability to acclimatize to changes in temperature, light, pCO2, and nutrient availability - at least within a finite range. However, the response of phytoplankton to multiple

simultaneous stressors is frequently complex, because the effects on physiological responses are interactive. To date, no datasets exist for even a single species that could fully test the assumptions and implications of existing models of phytoplankton acclimation to multiple environmental stressors. The investigators will combine modeling analysis with laboratory experiments to investigate the combined influences of changes in pCO2, temperature, light, and nitrate availability on phytoplankton growth using cultures of open ocean and coastal diatom strains (Thalassiosira pseudonana) and an open ocean cyanobacteria species (Synechococcus sp.). The planned experiments represent ideal case studies of the complex and interactive effects of environmental conditions on organisms, and results will provide the basis for predictive modeling of the response of phytoplankton taxa to multiple environmental stresses.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538602

[table of contents | back to top]