Results from laboratory experiments testing autoinduction in marine diatoms, Thalassiosira pseudonana and Phaeodactylum tricornutum (PhytoplanktonQS project)

Website: https://www.bco-dmo.org/dataset/514757
Data Type: experimental
Version: preliminary serving of final data
Version Date: 2014-05-09

Project
» Cell to cell communication in marine phytoplankton: population density control of cellular processes (PhytoplanktonQS)

Contributors	Affiliation	Role
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Dataset Description

Data from laboratory experiments testing the effect of auto-induction on the marine diatorms *Thalassiosira pseudonana* and *Phaeodactylum tricornutum*.

Methods & Sampling

Laboratory experiments were conducted to test auto-induction in marine diatoms. Experiments were conducted including initial tests to establish a reliable and repeatable protocol at each step of the experimental design. All findings are based on triplicate experiments, i.e. each treatment in triplicate.

For further details of Methods and Analytical Methodology, please contact the PI.

Data Processing Description

Data were plotted; points above or below one standard deviation were considered outliers. Averages and Standard Deviations were calculated from Excel.

Quality control: Several experimental designs failed and are not included. Only data of publishable quality are included in the data file.

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Data Files

File
marine_diatom_auto.csv (Comma Separated Values (.csv), 395.12 KB) MD5:281542c91df4ffa94d69c6c064bef70a Primary data file for dataset ID 514757

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Parameters

Parameter	Description	Units
species	specific taxonomic classification	none
expt_num	Sequential numbering system for each part of the experiment.	none
date_local	day/month/year of the experiment	dd/mm/yy
samp_name	FM = Fresh Medium; CM = Conditioned Medium; Because the display does not support '(prime) and "(double prime), those annotations were changed to 'prm' and 'dblprm'.	none
cell_conc	concentration of cells in the sample at the beginning of the experiment.	cells per milliliter
OD_blank	Optical Density of the blank at 750 nm. This dataset has three replicate measurements of Optical density blanks: OD_blank1, OD_blank2 and OD_blank3. They correspond to three measurements of the Optical density of the diatom concentration and set the location of the instrument zero.	optical density units
OD_blank_avg	Average of three blanks measured by the spectrophotometer.	optical density units
OD	Optical Density (OD) of the sample at 750 nm. OD1, OD2 and OD3 are replicate measurements.	optical density units
OD_avg_corr	Corrected OD average of the sample: OD sample minus OD blank	optical density units
avg_OD_triple	Average of the three replicate sample measurements: first, prime and doubleprime.	optical density units
OD_std_dev	Standard deviation of the triples measurements.	optical density units
pH	pH of the sample	pH units

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Instruments

Dataset-specific Instrument Name	Percival models LT-36VL and LT-41VLX
Generic Instrument Name	In-situ incubator
Generic Instrument Description	A device on a ship or in the laboratory that holds water samples under controlled conditions of temperature and possibly illumination.

Dataset-specific Instrument Name	ThermoScientific Orion Star LogR
Generic Instrument Name	pH Sensor
Dataset-specific Description	Accuracy to 2 decimal places.
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

Dataset-specific Instrument Name	Cary-100 UV-Visible spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Accurate to 4 decimal places
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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Deployments

Lab_UCSD_Vernet

Website	https://www.bco-dmo.org/deployment/514890
Platform	UCSD Vernet
Start Date	2011-07-01
End Date	2013-12-31
Description	This is the Vernet lab at Scripps/UCSD

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Project Information

Cell to cell communication in marine phytoplankton: population density control of cellular processes (PhytoplanktonQS)

Description from NSF award abstract:
Recent discoveries have shown that cell-cell communication extends from the intra-species to the inter-kingdom level and play pivotal roles in population-wide biological events such as changes in morphology, metabolic state and population structure. Quorum sensing (QS) is a communication process that allows single cells to cooperatively function as a decentralized network. Studies in prokaryotes and, more recently, fungi have demonstrated that QS regulates the timing of key biological processes such as colony formation, sporulation, morphological changes, pathogenicity and sexual reproduction. In the marine environment, QS has been demonstrated in bacteria however, this level of mutual cooperation has not been considered for phytoplankton populations. In view of the emerging literature on the critical role of cell-cell communication, it is timely to reconsider how we regard marine phytoplankton.

Thus far marine phytoplankton cell-cell interaction studies have primarily focused on chemical signals for competition against other species (e.g. allelopathy), predation deterrence and warning systems for environmental stress. There are several lines of circumstantial evidence to support QS in phytoplankton such as the timing of cell division, density dependent allelopathy and programmed cell death. However, to our knowledge there has been no direct experimentation to determine if phytoplankton can function in a cooperative consortium. Do they have a quorum sensing-type of communication to regulate intra-species processes as well as modulates inter-species interactions? Are recurrent phytoplankton communities established because these species are able to communicate with each member serving a specific role to maintain the population? These are difficult questions to address but have far reaching implications in our understanding of phytoplankton ecology.

This project will test whether phytoplankton have a QS system by examining the process of autoinduction (a basic tenant for QS) for specific biological events. The PIs will test this by examining two specific areas using phytoplankton ecological and physiological measurements coupled with state of the art bio-informatic and genomic tools:

1. Perform an extensive search for candidate phytoplankton QS-related genes in existing genomic and gene expression databases, based on homology with QS-related genes from other organisms. The PIs will conduct a detailed analysis to definitively map homologs of these QS regulatory pathways in their entirety as well as the few known biosynthetic pathways of QS compounds and transcriptional/translational regulators onto phytoplankton genomes. The results will be included as part of a comparative genomics study on cell-to-cell communication in phytoplankton, and the possible role of any candidate genes in QS will be tested by the experiments detailed below (2).

2. Establish autoinduction of cellular processes in a diatom species using an experimental approach. The PIs will focus on the autoinduction of growth, cell morphology, allelopathy and biofilm formation using axenic cultures using two model diatom species, Phaeodactylum tricornutum Bohlin and Thalassiosira pseudonana.

The establishment of a QS-like communication system will bring in a new perspective to our views on phytoplankton ecology beyond our current paradigm of bottom-up and top-down controls or competitive interactions. Results from this study will also influence our views on the factors controlling phytoplankton population diversity, as we will now have to consider the role of inter-species communication. Funding through an EAGER proposal will provide support for exploratory, high-risk research to obtain a minimum set of data as proof of concept of QS in phytoplankton.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1140042

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