Experimental results: Remineralization experiments to assess the ability of natural assemblages of bacteria to utilize DOM produced under Si and N limitation (SBDOM project, SBC LTER project)

Website: https://www.bco-dmo.org/dataset/518508
Data Type: experimental
Version: 1
Version Date: 2014-07-09

Project
» Mechanisms controlling the production and fate of DOM during diatom blooms (SBDOM)
» Santa Barbara Coastal Long Term Ecological Research site (SBC LTER)

Program
» Long Term Ecological Research network (LTER)

Contributors	Affiliation	Role
Carlson, Craig A.	University of California-Santa Barbara (UCSB-MSI)	Lead Principal Investigator
Brzezinski, Mark A.	University of California-Santa Barbara (UCSB-MSI)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Culture studies of diatoms that dominate spring blooms in the Santa Barbara Channel were used to examine the effects of N and Si stress on the magnitude of production and the chemical composition of DOM (see the BIB Experiments dataset). The ability of natural assemblages of bacteria to utilize DOM produced under Si and N limitation was then assessed using remineralization experiments. Species examined in the remineralization experiments include: Skeletonema marinoi, Chaetoceros socialis, Thalassiosira weissflogii, and Odontella aurita.

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Dataset Description

Culture studies of diatoms that dominate spring blooms in the Santa Barbara Channel were used to examine the effects of N and Si stress on the magnitude of production and the chemical composition of DOM (see the BIB Experiments dataset). The ability of natural assemblages of bacteria to utilize DOM produced under Si and N limitation was then assessed using remineralization experiments. Species examined in the remineralization experiments include: *Skeletonema marinoi*, *Chaetoceros socialis*, *Thalassiosira weissflogii*, and *Odontella aurita*.

Methods & Sampling

S. marinoi experimental design:
DOM was harvested from cultures of *S. marinoi* 48 hours after the indicated nutrient became deplete. Harvested media was 2x filtered through 0.2 um filters. Ambient seawater was the aged seawater media in which the phytoplankton were grown. Media (6L) and inoculum (2L, 1.2-um filtered water from the Santa Barbara Channel) were combined in a spigoted polycarbonate carboy and incubated in the dark at 14C for 4 months.

C. socialis experimental design:
DOM was harvested from cultures of *C. socialis* 48 hours after the indicated nutrient became deplete. Harvested media was 2x filtered through 0.2 um filters. Ambient seawater was the aged seawater media in which the phytoplankton were grown. Media (6L) and inoculum (2L, 1.2-um filtered water from the Santa Barbara Channel) were combined in a spigoted polycarbonate carboy and incubated in the dark at 14C for 4 months.

T. weissflogii experimental design:
DOM was harvested from cultures of *T. weissflogii* 48 hours after the indicated nutrient became deplete. Harvested media was 2x filtered through 0.2 um filters. Ambient seawater was the aged seawater media in which the phytoplankton were grown. Media (6L) and inoculum (2L, 1.2-um filtered water from the Santa Barbara Channel) were combined in a spigoted polycarbonate carboy and incubated in the dark at 14C for 4 months.

O. aurita experimental design:
DOM was harvested from cultures of *O. aurita* 48 hours after the indicated nutrient became deplete. Harvested media was 2x filtered through 0.2 um filters. Ambient seawater was the aged seawater media in which the phytoplankton were grown. This experiment included full-volume inorganic nutrient controls (ambient seawater with added nitrate and phosphate or silicate and phosphate, at concentrations comparable to the Si-limited and N-limited treatments, respectively) and small-volume (2L, same media:inoculum ratio) controls to look at carry-over from the phytoplankton media that were sampled less frequently and with fewer replicates (ambient seawater plus f/2 and ambient seawater plus filtered media from an *O. aurita* culture in exponential growth, both at concentrations comparable to those at the start of the *O. aurita* batch culture grow-ups). Media (6L) and inoculum (2L, 1.2-um filtered water from the Santa Barbara Channel) were combined in a spigoted polycarbonate carboy and incubated in the dark at 14C for 4 months.

Data Processing Description

BCO-DMO processing notes:
- Changed paramter names to conform to BCO-DMO naming conventions.
- Replaced N/A and blanks with 'nd' to indicate 'no data'.
- In original 'DNA_sampled' column, replaced X with 'yes' and blanks with 'no'.
- Separated original treatment column into treatment and replicate.

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Data Files

File
remins_expt.csv (Comma Separated Values (.csv), 79.56 KB) MD5:50b33bfcaae2e9df4f2591fb1e3c7232 Primary data file for dataset ID 518508

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Parameters

Parameter	Description	Units
species	Name of the species.	text
treatment	Treatment condition.	text
replicate	Replicate number.	integer
time_point	Sampling time point.	integer
days_elapsed	Number of days elapsed since the start of the experiment.	number
DOC	Dissolved organic carbon.	micromoles per Liter (umol/L)
DOC_sd	Standard deviation of DOC.	micromoles per Liter (umol/L)
TDN	Total dissolved nitrogen.	micromoles per Liter (umol/L)
TDN_sd	Standard deviation of TDN.	micromoles per Liter (umol/L)
NO3_NO2	Nitrate and nitrite.	micromoles per Liter (umol/L)
NH4	Concentration of NH4.	micromoles per Liter (umol/L)
PO4	Concentration of PO4.	micromoles per Liter (umol/L)
dSi	Dissolved SO4.	micromoles per Liter (umol/L)
bact_abund_FCM	Bacterial cell abundance measured via flow cytometer using SYBR Green stain.	cells per Liter (cells/L)
bact_abund_DAPI	Bacterial cell abundance measured via epifluorescence microscopy using DAPI stain.	cells per Liter (cells/L)
bact_abund_DAPI_sd	Standard deviation of bact_abund_DAPI.	cells per Liter (cells/L)
bact_prod	Bacterial production measured via 3H leucine uptake.	picomoles Leucine per Liter per hour (pmol Leu/L/hr)
bact_prod_sd	Standard deviation of bact_prod.	picomoles Leucine per Liter per hour (pmol Leu/L/hr)
specifc_growth_rate	Specific growth rate (μ) over exponential growth phase.	per day
bact_growth_eff	Bacterial growth efficiency over exponential growth phase.	unitless
DNA_sampled	yes = sample was collected; analyzed samples still in QC.	yes or no

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Project Information

Mechanisms controlling the production and fate of DOM during diatom blooms (SBDOM)

Coverage: Pacific California, Santa Barbara Channel

This project is also affiliated with the Plumes and Blooms project.

Data:
The following data files have been submitted to BCO-DMO but are not yet available online. Data are restricted until June 2016. Please contact the PI for access prior to public availability:
-- SBDOM10 and SBDOM11 CTD and Niskin bottle data.

The following are available online (see 'Datasets' heading below):
-- SBDOM10 and SBDOM11 cruise plans (available online on deployment pages: PS1009, PS1103)
-- SBDOM10 and SBDOM11 event logs (available online; see 'Datasets' below)
-- Laboratory-based Bloom in a Bottle (BIB) Experiment
-- Laboratory-based Remineralization Experiments
-- SBDOM10 and SBDOM11 data summaries (including CTD data, nutrients, and bacterial production)

Project Description from NSF Award Proposal and Abstract:
Diatom blooms are known to produce prodigious quantities of DOM upon entering nutrient stress with a chemical composition that varies with the type of nutrient limitation (Si or N). This variable composition likely influences the nutritional value of DOM to microbes driving species successions towards functional groups of heterotrophic prokaryotes that are best able to metabolize particular forms of DOM. To date each side of this coupled system of production/consumption has been examined independently. A few studies have

examined how limitation by different limiting nutrients affects the chemical character of the DOM produced by phytoplankton, while others have focused on the fate of DOM without detailed understanding of the mechanisms influencing its initial chemical composition.

We propose to investigate the mechanisms determining the character and fate of DOM produced during temperate diatom blooms. Specifically we will investigate how physiological stress on diatoms induced by different limiting nutrients influences the production, chemical composition of DOM and the microbial community structure that respond to it to better understand the mechanisms driving the accumulation and persistence of DOM in marine systems. The research will involve both laboratory and field experiments. The novel aspects of this work are:
1) We will investigate how limitation by either N or Si impacts the quantity and chemical composition of the DOM released by diatoms.
2) Assess how the differences in the chemical composition of the DOM produced under N or Si limitation affect its lability by examining the productivity, growth efficiency and community structure of heterotrophic bacterioplankton responding to the release of substrates.
3) Predicted DOM dynamics based on (1) and (2) will be tested in the field during diatom blooms in the Santa Barbara Channel, California.

While experiments investigating aspects of either 1 or 2 have been conducted successfully in the past (Lancelot, 1983; Billen and Fontigny, 1987; Goldman et al., 1992; Carlson et al.,1999; Cherrier and Bauer, 2004; Conan et al., 2007) ours will be the first study to combine these approaches in an integrated assessment of the mechanisms governing both the production and fate of DOM produced by diatom blooms experiencing limitation by different nutrients.

References:
Lancelot, C. (1983). Factors affecting phytoplankton extracellular release in the Southern Bight of the North Sea. Marine Ecology Progress Series 12: 115-121.

Billen, G. and A. Fontigny (1987). Dynamics of a Phaeocystis -dominated spring bloom in Belgian coastal waters. II. Bacterioplankton dynamics. Mar. Ecol. Prog. Ser. 37: 249-257.

Goldman, J.C., D.A. Hansell and M.R. Dennett (1992). Chemical characterization of three large oceanic diatoms: potential impact on water column chemistry. Marine Ecology Progress Series 88: 257-270.

Carlson, C.A., N.R. Bates, H.W. Ducklow and D.A. Hansell (1999). Estimation of bacterial respiration and growth efficiency in the Ross Sea, Antarctica. Aquatic Microbial Ecology 19: 229-244.

Cherrier, J. and J.E. Bauer (2004). Bacterial utilization of transient plankton-derived dissolved organic carbon and nitrogen inputs in surface ocean waters. Aquatic Microbial Ecology 35(3): 229-241.

Conan, P., M. Sondegaard, T. Kragh, F. Thingstad, M. Pujo-Pay, P.J.l.B. Williams, S. Markager, G. Cauwet, N.H. Borch, D. Evans and B. Rieman (2007). Partitioning of organic production in marine plankton communities: The effects of inorganic nutrient ratios and community composition on new dissolved organic matter. Limnology and Oceanography 52(2): 753-765.

Santa Barbara Coastal Long Term Ecological Research site (SBC LTER)

Website: http://sbc.lternet.edu/

Coverage: Southern California Coastal Zone

From http://www.lternet.edu/sites/sbc
The Santa Barbara Coastal LTER is located in the coastal zone of southern California near Santa Barbara. It is bounded by the steep east-west trending Santa Ynez Mountains and coastal plain to the north and the unique Northern Channel Islands archipelago to the south. Santa Barbara Coastal Long-Term Ecological Research (SBC) Project is headquartered at the University of California, Santa Barbara, and is part of the National Science Foundation's (NSF) Long-Term Ecological Research (LTER) Network.

The research focus of SBC LTER is on ecological systems at the land-ocean margin. Although there is increasing concern about the impacts of human activities on coastal watersheds and nearshore marine environments, there have been few long-term studies of the linkages among oceanic, reef, sandy beaches, wetland, and upland habitats. SBC LTER is helping to fill this gap by studying the effects of oceanic and coastal watershed influences on kelp forests in the Santa Barbara Channel located off the coast of southern California. The primary research objective of SBC LTER is to investigate the relative importance of land vs. ocean processes in structuring giant kelp (Macrocystis pyrifera) forest ecosystems for different conditions of land use, climate and ocean influences.

SBC LTER Data: The Santa Barbara Coastal (SBC) LTER data are managed by and available directly from the SBC project data site URL shown above. If there are any datasets listed below, they are data sets that were collected at or near the SBC LTER sampling locations, and funded by NSF OCE as ancillary projects related to the SBC LTER core research themes. See the SBC LTER Data Overview page for access to data and information about data management policies.

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Program Information

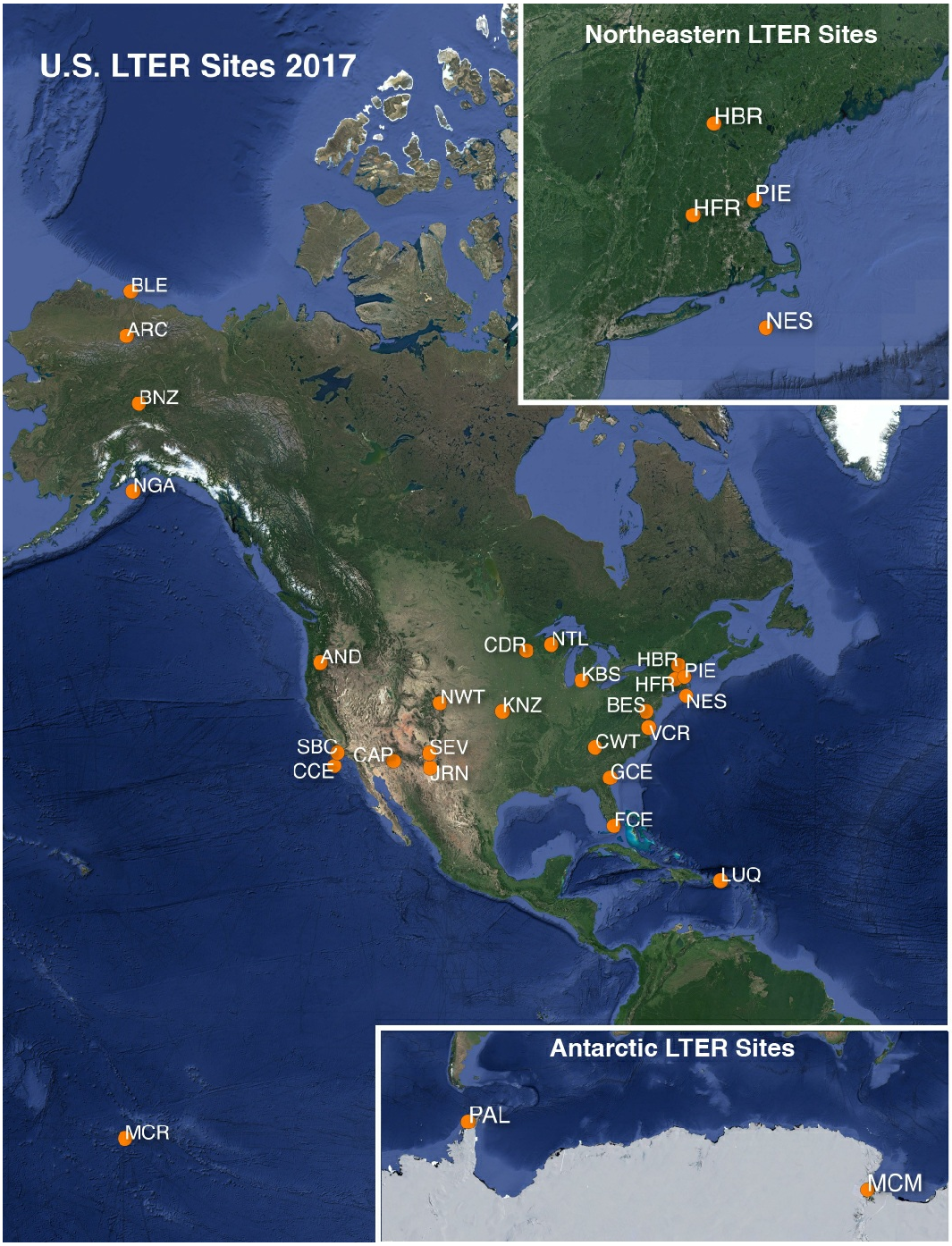
Long Term Ecological Research network (LTER)

Website: http://www.lternet.edu/

Coverage: United States

adapted from http://www.lternet.edu/

The National Science Foundation established the LTER program in 1980 to support research on long-term ecological phenomena in the United States. The Long Term Ecological Research (LTER) Network is a collaborative effort involving more than 1800 scientists and students investigating ecological processes over long temporal and broad spatial scales. The LTER Network promotes synthesis and comparative research across sites and ecosystems and among other related national and international research programs. The LTER research sites represent diverse ecosystems with emphasis on different research themes, and cross-site communication, network publications, and research-planning activities are coordinated through the LTER Network Office.



2017 LTER research site map obtained from https://lternet.edu/site/lter-network/

Site Codes

AND	Andrews Forest LTER
ARC	Arctic LTER
BES	Baltimore Ecosystem Stu
BLE	Beaufort Lagoon Ecosystems LTER
BNZ	Bonanza Creek LTER
CCE	California Current Ecosystem LTER
CDR	Cedar Creek Ecosystem Science Reserve
CAP	Central Arizona-Phoenix LTER
CWT	Coweeta LTER
FCE	Florida Coastal Everglades LTER
GCE	Georgia Coastal Ecosystems LTER
HFR	Harvard Forest LTER
HBR	Hubbard Brook LTER
JRN	Jornada Basin LTER
KBS	Kellogg Biological Station LTER
KNZ	Konza Prairie LTER
LUQ	Luquillo LTER
MCM	McMurdo Dry Valleys LT
MCR	Moorea Coral Reef LTEF
NWT	Niwot Ridge LTER
NTL	North Temperate Lakes I
NES	Northeast U.S. Shelf LTE
NGA	Northern Gulf of Alaska I
PAL	Palmer Antarctica LTER
PIE	Plum Island Ecosystems LTER
SBC	Santa Barbara Coastal L
SEV	Sevilleta LTER
VCR	Virginia Coast Reserve L

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850857

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