Bacteria, picoeukaryote, and Synecoccus cell counts, nutrients (POC, PON, POP) and chlorophyll from nitrate and vitamin-B enriched treatments, from up-welled coastal waters off Southern California, March 2015 (B-vitamin plankton succession project)

Website: https://www.bco-dmo.org/dataset/726253
Data Type: experimental
Version: 1
Version Date: 2018-02-02

Project
» Can the availability of B-vitamins control phyto-and-bacterioplankton successions in a coastal upwelling region? (B-vitamin plankton succession)

Contributors	Affiliation	Role
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Abstract
This dataset includes nutrients (POC, PON, POP) and chlorophyll concentrations, and cell counts for picoplankton (picoeukaryotes, Synechococcus, bacteria) collected in water samples from the San Pedro Ocean Time-series (SPOT), 2015. They were incubated with six treatments of nitrate and vitamin B.

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Coverage

Spatial Extent: **Lat**:33.5478 **Lon**:-118.3983
Temporal Extent: 2015-03-11 - 2015-03-23

Dataset Description

This dataset includes nutrients (POC, PON, POP) and chlorophyll concentrations, and cell counts for picoplankton (picoeukaryotes, Synechococcus, bacteria) collected in water samples from the San Pedro Ocean

Time-series (SPOT), 2015. They were incubated with six treatments of nitrate and vitamin B.

Methods & Sampling

Water samples were collected from 3 meters depth at the San Pedro Ocean Time-series (SPOT) station (33°33'N, 118°24'W) off the coast of Southern California in March 2015. Six treatments were used: control, nitrate, nitrate+B1, nitrate+B7, nitrate+B12, and nitrate+B1+B7+B12 with triplicate 10L incubations. Growth was tracked daily. Samples were collected initially, and at two points during the experiment: exponential growth and stationary phase. Exponential growth occurred at day 7 and stationary growth varied between treatment ranging from 10-12 days. The incubations were co-limited by nitrate and B12. Samples were flash frozen and stored at -80C until analysis. For further details on the methodology, see Suffridge et al (2017).

Cell counts were made with using flow cytometry. Samples for flow cytometry were collected, fixed with 2% formalin, and frozen at -80C. Analysis for the cellular abundance of heterotrophic bacteria, Synechococcus, and pircoeukaryotes was conducted using a BD Accuri C6 flow cytometer (Becton Dickerson and Company).

Elemental ratios were obtained by measuring particulate organic nutrients: carbon and nitrogen (POC and PON), and particulate organic phosphorus (POP). For particulate organic carbon and nitrogen (POC and PON), 100 ml was filtered onto pre-combusted POC and PON were analyzed on a Costech Elemental Analyzer using methionine and acetanilide as references to calibrate the system at the beginning of the measurements (Fu et al. 2007).

For particulate organic phosphorus (POP) samples, 40 mls were filtered onto precombusted (500°C, 2 h) GF/F filters and rinsed twice with 2 ml 0.17 mol L-1 Na2SO4 solution. The filters were placed in 20 ml borosilicate scintillation vials (pre-combusted at 500°C, overnight) to which was added 2ml 0.017 mol L-1 MgSO4 solution. The vials were then covered with aluminum foil and dried at 95 °C, followed by combustion at 450-500 °C for 2 h. After cooling to room temperature, 5 ml of 0.2 mol L-1 HCl solution was added to each vial, which were then tightly capped and heated at 80°C for thirty minutes to digest POP into inorganic phosphate. The standard molybdate colorimetric method was used to analyze the samples (Solorzano and Sharp 1980). Three GF/F filters were treated in the same way as the samples for blank determinations. POP quantification was done using a Shimadzu UV-1800 UV/Visible Scanning Spectrophotometer.

Chl-a concentrations were measured using the protocol described by Welschmeyer (1994). 40 ml of water samples from each replicate were filtered through GF/F glass fiber filters, 3.0-µm and 8.0-µm polycarbonate membrane for size fractionated Chl-a analyses. After adding 6 ml of 90% acetone, Chl-a was extracted in the freezer at -20°C and measured using the non-acidification method with a Turner Designs 10-AUTM fluorometer after 24 hours.

Data Processing Description

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- reformatted columns by replacing 'analyte' and 'organism' columns with new columns POC, PON, POP, chla_gff, chla_3um, chla_7_3um, picoeukaryotes, Synechococcus, and bacteria -replacing type, units, and value in order to keep one type of data in each column.
- changed 'syn' to 'Synechococcus', 'PEUK' to 'picoeukaryotes', 'bac' to 'bacteria', CHlA and CHLA to Chla
- changed B1, B7, B12 to N+B1, N+B7, N+B12
- reduced decimal precision
- changed dates from 2011 to 2015

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Data Files

File
Vitacopss_biomass.csv (Comma Separated Values (.csv), 4.36 KB) MD5:9ec46569fdee8bfe6d9447d0b85ef416 Primary data file for dataset ID 726253

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Related Publications

Fu, F.-X., Warner, M. E., Zhang, Y., Feng, Y., & Hutchins, D. A. (2007). Effects of Increased temperature and CO2 on photosynthesis, growth, and elemental ratios in marine Synechococcus and Prochlorococcus (cyanobacteria). Journal of Phycology, 43(3), 485–496. doi:10.1111/j.1529-8817.2007.00355.x
Methods

Sanudo-Wilhelmy, S. A., Cutter, L. S., Durazo, R., Smail, E. A., Gomez-Consarnau, L., Webb, E. A., … Karl, D. M. (2012). Multiple B-vitamin depletion in large areas of the coastal ocean. Proceedings of the National Academy of Sciences, 109(35), 14041–14045. doi:10.1073/pnas.1208755109
General

Solórzano, L., & Sharp, J. H. (1980). Determination of total dissolved phosphorus and particulate phosphorus in natural waters1. Limnology and Oceanography, 25(4), 754–758. doi:10.4319/lo.1980.25.4.0754
Methods

Suffridge, C., Cutter, L., & Sañudo-Wilhelmy, S. A. (2017). A New Analytical Method for Direct Measurement of Particulate and Dissolved B-vitamins and Their Congeners in Seawater. Frontiers in Marine Science, 4. doi:10.3389/fmars.2017.00011
Methods

Waterbury, J., Watson, S., Valois, F., and Franks, D. (1986). Biological and ecological characterization of the Marine Unicellular Cyanobacterium Synechococcus. Can. Bull. Fish. Aquat. Sci. 214, 71-120.
Methods

Welschmeyer, N. A. (1994). Fluorometric analysis of chlorophyll a in the presence of chlorophyll b and pheopigments. Limnology and Oceanography, 39(8), 1985–1992. doi:10.4319/lo.1994.39.8.1985
Methods

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Parameters

Parameter	Description	Units
sampleid	sample identifier	unitless
treatment	treatments: control; nitrate (N); nitrate+B1 (N+B1); nitrate+B7 (N+B7); nitrate+B12 (N+B12); and nitrate+B1+B7+B12 (All)	unitless
timepoint	code for sampling period during one of three growth phases of the population: 0=initial sampling; 1=exponential phase; 2=stationary phase. Dates: 2015-03-12 (time 0); 2015-03-20 (time 1); 2015-03-25 (time 2)	unitless
date	date of experiment formatted as yyyy-mm-dd	unitless
sizefrac	size fraction of filtered sample; either 0.2 microns (picoplankton) or 3 microns (nanoplankton and microplankton)	microns
biorep	sample replicate identifier	unitless
POC	Particulate Organic Carbon concentration	micromoles/Liter
PON	Particulate Organic Nitrogen concentration	micrograms/L
POP	Particulate Organic Phosphorous concentration	micrograms/L
chla_gff	Chlorophyll-a Rf as collected with GFF filter	unitless
Chla_3um	Chlorophyll-a Rf as collected with a 3 micron filter	unitless
Chla_7_3um	Chlorophyll-a Rf of fraction between 0.7 and 3 microns	unitless
picoeukaryotes	cell count of picoeukaryotes	cells/milliliter
Synechococcus	cell count of Synechococcus	cells/milliliter
bacteria	cell count of bacteria	cells/milliliter

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	BD Accuri C6 flow cytometer (Becton Dickerson and Company)
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	Used for cell counts. Samples for flow cytometry were collected, fixed with 2% formalin, and frozen at -80C. Analysis for the cellular abundance of heterotrophic bacteria, Synechococcus, and pircoeukaryotes was conducted using a BD Accuri C6 flow cytometer (Becton Dickerson and Company).
Generic Instrument Description	Flow cytometers (FC or FCM) are automated instruments that quantitate properties of single cells, one cell at a time. They can measure cell size, cell granularity, the amounts of cell components such as total DNA, newly synthesized DNA, gene expression as the amount messenger RNA for a particular gene, amounts of specific surface receptors, amounts of intracellular proteins, or transient signalling events in living cells. (from: http://www.bio.umass.edu/micro/immunology/facs542/facswhat.htm)

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Costech Elemental Analyzer
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	Used to measure particulate organic nutrients: carbon and nitrogen (POC and PON).
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

Dataset-specific Instrument Name	Shimadzu UV-1800 UV/Visible Scanning Spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Used to measure particulate organic phosphorus (POP).
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_Sanudo_2015

Website	https://www.bco-dmo.org/deployment/653467
Platform	R/V Yellowfin
Start Date	2015-03-01
End Date	2016-06-01

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Project Information

Can the availability of B-vitamins control phyto-and-bacterioplankton successions in a coastal upwelling region? (B-vitamin plankton succession)

Coverage: Southern California Bight

Description from NSF award abstract:
B-vitamins (thiamin (B1), biotin (B7), and cobalamin (B12)) are organic molecules used by all organisms for many biochemical reactions ranging from DNA and amino acid synthesis to carbon dioxide assimilation. Despite their metabolic importance, many marine organisms cannot make them and need to obtain them from the environment. Because the requirement for a specific vitamin is different for different organisms, changes in the species composition of algae could be explained by their different B-vitamin requirements. For example,

changes in the biological properties of waters during an algal bloom (removal of needed vitamins and release of other vitamins) may favor algae that require the vitamin released by the previous bloom (setting up a floral succession). This selective preconditioning of the waters may be one factor in the seasonal succession of algal species. However, evaluating the role of vitamins in marine ecology has been difficult. No study to date has been comprehensive enough to estimate the importance of vitamins in primary productivity and species succession. This is especially true in coastal upwelling regions that although relatively small in area, are orders of magnitude more productive than their open-ocean counterparts. In fact, those regions contribute a significant portion of the world fisheries. Therefore, in order to try to predict future changes in the world ocean due to human activity, the variables that influence or control the algal communities that dominate the very productive food chains of upwelling regions need to be identified.

This study will investigate how the availability of B-vitamins affects the dynamics of algal- and bacterioplankton population growth in coastal waters of an upwelling region off Southern California. This comprehensive field investigation will determine in situ temporal concentrations of several dissolved and particulate B-vitamins, inorganic micro- and macronutrients, concurrently with seasonal changes in phytoplankton and bacterial abundances and species composition at a long-term time series station within the San Pedro Basin near Los Angeles. Those measurements will be complemented with field incubation experiments with natural plankton assemblages to study the effect of organic and inorganic nutrient amendments on phytoplankton and bacterial community structure. This study will establish for the first time that the availability of ambient B-vitamins influence algal and bacterial species succession in a highly productive coastal upwelling region and that multiple and differing B-vitamin requirements limit growth of some phytoplankton species in those areas. Furthermore, this study will try to show that coastal upwelling transports some B-vitamins to the phytoplankton community in the photic zone from bacterially-influenced source waters within the upper mesopelagic zone.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1435666

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