Size-fractioned primary production (14C-bicarbonate assimilation rates) from samples collected during Hawaii Ocean Time-series (HOT) cruises from 2011-2013 (PhytoNsubResponse project)

Website: https://www.bco-dmo.org/dataset/722854
Version:

Project
» Oligotrophic phytoplankton community response to changes in N substrates and the resulting impact on genetic, taxonomic and functional diversity (PhytoNsubResponse)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

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Dataset Description

These data have been submitted to BCO-DMO and are in the process of being served.

These data contain rates of 14C-bicarbonate assimilation from nitrogen perturbation experiments conducted at Station ALOHA using 25 m seawater during HOT and CMORE cruises between 2011 and 2013.

Methods & Sampling

Sampling and Analytical Methodology:

Experiments were conducted between July 2011 and April 2013 during five research cruises to Station ALOHA (22.75°N, 158°W), the well-characterized study site of the Hawaii Ocean Time-series (HOT) program. Sampling occurred during four HOT cruises and one Center for Microbial Oceanography: Research and Education (C-MORE) cruise (termed HOE-DYLAN 5) aboard the R/V Kilo Moana. Seawater was collected in 12 L polyvinylchloride bottles affixed to a 24-bottle rosette sampler equipped with a Sea-Bird 911+ conductivity, temperature, and depth profiler. Nine 20-L polycarbonate carboys were filled with 25 m Station ALOHA seawater pre-filtered off the rosette sampler through a Nitex mesh (pore size ~202 µm) to exclude larger zooplankton. Of these, 3 carboys received additions of nitrate (target ~2.8 µM N final concentration as $NaNO_3$) and three carboys received additions of ammonium (target ~2.8 µM N final concentration as NH_4Cl). All

carboys, including three ‘Control’ carboys, received additions of phosphate (target ~0.2 µM P final concentration as KH_2PO_4) and silicic acid (target ~2.8 µM Si final concentration as Na_2SiO_3) to achieve a final N:P:Si stoichiometric ratio (14:1:14). Carboys were incubated for 120 to 144 hours and subsampled at approximately daily scales throughout the experiment (Table 1). All sampling was conducted before sunrise in order to allow productivity rate measurements to span the full photoperiod.

Rates of size-fractionated (0.2-3 µm and >3 µm) primary production were assessed based on the assimilation of 14C-bicarbonate into particulate organic matter. Seawater was collected into 30 mL polycarbonate centrifuge tubes (Nalgene™ Oak Ridge) before sunrise, spiked under subdued light with 70 µL of NaH14CO3- (MP Biomedicals 17441H, stock concentration 2 mCi ml-1) to a final activity of ~0.14 MBq NaH14CO3- mL-1. The tubes were placed in white mesh bags in the same incubator as the experiment carboys over the full photoperiod (~12-14 hours). After sundown, 25 µL aliquots from each sample were collected and stored in 20 mL glass scintillation vials containing 500 µL of β–phenylethylamine to determine the total activity of 14C added to each sample. The remaining sample volume (~25 mL) was serially vacuum-filtered, first onto 25 mm diameter, 3 µm pore size polycarbonate membranes, then onto 25 mm diameter, 0.2 µm pore size membranes. After filtration, each filter was placed in 20 mL glass scintillation vials, to which 1 mL of 2 M hydrochloric acid was added and vented for at least 24 hours to remove adsorbed 14C-bicarbonate. Ten mL of Ultima Gold liquid scintillation cocktail was then added to each vial and placed in a liquid scintillation counter for the determination of 14C activities.

Seawater samples (2 mL) for photosynthetic picoeukaryote cell abundance measurements were collected for each experiment into cryotubes (Corning) containing 30 µl of 16% paraformaldehyde for a final concentration of 0.24% (w/v), kept for 15 minutes in the dark, flash-frozen in liquid nitrogen, and stored at -80°C until analyzed. Photosynthetic picoeukaryote cells were distinguished using a BD InfluxTM flow cytometer (triggered on forward scatter) with the data acquisition software Spigot. Cells were enumerated based on forward scatter, side scatter, chlorophyll-based red fluorescence (692 ± 20 nm), and phycoerythrin-based orange fluorescence (585 ± 20 nm) on two lasers, 488 nm and 457 nm. Cell counts were determined using the data analysis software FlowJo 10.0.7.

For photosynthetic pigment analyses using high performance liquid chromatography (HPLC), seawater (2 L) was collected into brown, narrow-mouthed HDPE bottles and subsequently filtered using a peristaltic pump onto 25 mm diameter, GF/F filters. Filters were immediately flash-frozen in liquid nitrogen and stored at -80°C until analyzed. Photosynthetic pigments were extracted from the filters in 3 mL 100% acetone (HPLC grade) in culture tubes along with 50 µL canthaxanthin, an internal standard, and placed at 4oC for 24 hours. Chlorophyll and carotenoid pigments were separated on a Varian 9012 HPLC system and analyzed using SpectraSYSTEM Thermo Separation Products dual wavelength UV/VIS UV2000 and fluorescence FL2000 detectors. Pigment identifications were based on absorbance spectra, co-chromatography with standards, and relative retention time with a monovinyl Chl a standard and representative culture extracts, and Spectra-Physics WOW® software was used to calculate peak area.

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Packard TRI-Carb 4640
Generic Instrument Name	Liquid Scintillation Counter
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples. Liquid scintillation counters are instruments assaying alpha and beta radiation by quantitative detection of visible light produced by the passage of rays or particles through a suitable scintillant incorporated into the sample.

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Deployments

HOT_cruises

Website	https://www.bco-dmo.org/deployment/58879
Platform	Multiple Vessels
Report	http://hahana.soest.hawaii.edu/hot/
Start Date	1988-10-31
Description	Since October 1988, the Hawaii Ocean Time-series (HOT) program has investigated temporal dynamics in biology, physics, and chemistry at Stn. ALOHA (22°45' N, 158°W), a deep ocean field site in the oligotrophic North Pacific Subtropical Gyre (NPSG). HOT conducts near monthly ship-based sampling and makes continuous observations from moored instruments to document and study NPSG climate and ecosystem variability over semi-diurnal to decadal time scales. **Methods & Sampling** Hawaii Ocean Time-series (HOT) program cruises 230-252

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Project Information

Oligotrophic phytoplankton community response to changes in N substrates and the resulting impact on genetic, taxonomic and functional diversity (PhytoNsubResponse)

Coverage: North Pacific Subtropical Gyre at Station ALOHA, and a transect from San Diego, CA to Hawaii

(Extracted from NSF award abstract)

Marine phytoplankton are a diverse group of Prokaryotic and Eukaryotic unicellular organisms that account for approximately 50% of global carbon fixation. Nitrogen (N) is an essential element for microbial growth, but concentrations of bioavailable nitrogen in vast regions of subtropical ocean gyres are extremely low (submicromolar to nanomolar concentrations), and generally limit phytoplankton growth. Phytoplankton taxa differ in their genetic capabilities to take up and assimilate nutrients, and thus competition for different chemical forms of N (NH_4^+, NO_3^- and urea) and supply of these N-containing compounds are important controls on phytoplankton growth, productivity, and ultimately ecosystem function. The form and supply of N

to phytoplankton have already been altered by anthropogenic activities, and with increasing environmental perturbations the effects will accelerate. To date however, there is limited information on how the N forms and fluxes impact the marine phytoplankton community composition and primary production. Similarly, determining the mechanisms of the response are crucial to assessing how ocean ecosystem function will respond to global climate change.

This project seeks to determine how taxonomic, genetic and functional dimensions of phytoplankton diversity are linked with community-level responses to the availability of different N substrates (NH4+, NO3-, and urea) in one of Earth's largest aquatic habitats, the North Pacific Subtropical Gyre. The project will characterize phytoplankton community composition change and gene expression, photosynthetic performance, carbon fixation, and single-cell level N and C uptake in different taxa within the phytoplankton assemblage in response to different N compounds. The research project is unique in investigating community-to-single-cell level function and species (strain)-specific gene expression patterns using state-of-the-art methods including fast repetition rate fluorometry, nanoscale secondary ion mass spectrometry and a comprehensive marine microbial community microarray. The results will provide predictive understanding of how changes in the availability of key nitrogen pools (N) may impact phytoplankton dynamics and function in the ocean.

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Letelier, R., Karl, D. M. 1996. Role of Trichodesmium spp. in the productivity of the subtropical North Pacific Ocean. Marine Ecology Progress Series. 133:263 - 273.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1241263

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