Phytoplankton abundances from experiments on R/V Seward Johnson SJ0516 cruise between Ireland and Iceland during the 2005 North Atlantic Spring Bloom (NASB 2005 project, Antarctic microzooplankton project)

Website: https://www.bco-dmo.org/dataset/3888
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Project
» North Atlantic Spring Bloom 2005 (NASB 2005)
» Rising climatic temperatures impact on antarctic microzooplankton growth and grazing (Antarctic microzooplankton)

Contributors	Affiliation	Role
Rose, Julie	National Oceanic and Atmospheric Administration (NOAA-Milford)	Principal Investigator
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Dataset Description

Experiment Description:
The experiment was conducted onboard the RV Seward Johnson II, from June 20 to July 4, 2005, with water collected at 57° 58' N, 15° 32'W. Four treatments were used with 6 replicates each: (1) 12°C and 390 ppm CO_2 (LTLC), (2) 12°C and 690 ppm CO_2 (LTHC), (3) 16°C and 390 ppm CO_2 (HTLC), and (4) 16°C and 690 ppm CO_2 (HTHC). Sea surface temperature at this location was 12°C at the time of water collection. Experiments were run using a seawater continuous culture system, termed an 'Ecostat' (Hutchins et al. 2003, Hare et al. 2005, 2007). Briefly, whole seawater was collected from 5 to 10 m depth using a trace-metal-clean, towed-intake Teflon pump system (Hutchins et al. 2003), prefiltered through 200 µm Nitex mesh to remove mesozooplankton and incubated in twenty-four 2.7 l trace-metal-clean, clear polycarbonate bottles. Bottles were placed in racks in a temperature-controlled deck incubator with recirculating water and shaded to 30 percent of surface irradiance (I0) using a neutral-density shade screen. Temperatures in the 16°C incubator were gradually increased over a period of 24 h to avoid heat-shocking the plankton. Bottles were bubbled with either air or a commercially prepared air/CO2 mixture with 750 ppm CO2 using an inflow tube through the cap and an airstone to maximize gas transfer to the liquid phase. The gases used for bubbling were filtered through a 0.2 µm HEPA filter to avoid contamination of experimental bottles by trace metals (Hare et al. 2005). The system was run in batch mode for 3 days prior to turning on the pumps, in order to stimulate phytoplankton growth and prevent wash-out of slower growing species. After this batch growth period, whole seawater in each incubation bottle was slowly diluted at a continuous rate using seawater collected at the initial

site. This seawater medium was filtered through a 0.2 µm inline capsule filter initially, then re-filtered through a second 0.2 µm inline capsule filter immediately prior to use as a diluent. The medium was stored in trace-metal-clean, 50 l carboys in the dark. Initial in situ nutrient concentrations were low (0.32 umol nitrate l^{-1}, 0.12 umol phosphate l^{-1}, 0.7 umol silicate l^{-1}), so the medium and the whole water in the incubation bottles were amended with 5 and 0.31 umol l^{-1} (final concentration) of nitrate and phosphate. The dilution rate of 0.5 d^{-1} was controlled in each incubation bottle using a peristaltic pump and calibrated daily to ensure constant flow rate. This flow rate constituted a 50 percent dilution of the experimental bottle volume daily. Incubation bottles were mixed by inverting the rack 120° every 5 to 15 min using a compressed-air-driven system. Diluted seawater flowed out of the incubation bottles at a continuous rate and into 2.7 l polycarbonate bottles stored in the dark, which were used as outflow collection vessels. Seawater carbonate system measurements were performed as described in Feng et al. (2009).

References:
Feng, Y., C.E. Hare, K. Leblanc, G.R. DiTullio, P.A. Lee, S.W. Wilhelm, J. Sun, J.M. Rose, N. Nemcek, I. Benner, and D.A. Hutchins. 2009. The effects of increased pCO2 and temperature on the North Atlantic Spring Bloom: I. The phytoplankton community and biogeochemical response. Marine Ecology Progress Series 388: 13-25.

Hare, C.E., G.R. DiTullio, C.G. Trick, S.W. Wilhelm, K.W. Bruland, E.L. Rue, and D.A. Hutchins. 2005. Phytoplankton community structure changes following simulated upwelled iron inputs in the Peru upwelling region. Aquatic Microbial Ecology 38: 269-282.

Hare, C.E., K. Leblanc, G.R. DiTullio, R.M. Kudela, Y. Zhang, P.A. Lee, S.F. Riseman, and D.A. Hutchins. 2007. Consequences of increased temperature and CO2 for phytoplankton community structure in the Bering Sea. Marine Ecology Progress Series 352: 9-16.

Hutchins, D.A., F. Pustizzi, C.E. Hare, and G.R. DiTullio. 2003. A shipboard natural community continuous culture system for ecologically relevant low-level nutrient enrichment experiments. Limnology and Oceanography: Methods 1: 82-91.

Related files and references:
Rose, J.M., Y. Feng, C.J. Gobler, R. Gutierrez, C.E. Hare, K. Leblanc, and D.A. Hutchins. 2009. The effects of increased pCO2 and temperature on the North Atlantic Spring Bloom. II. Microzooplankton abundance and grazing. Marine Ecology Progress Series 388: 27-40.

Additional parameters measured during these experiments are described in: Feng, Y., C.E. Hare, K. Leblanc, G.R. DiTullio, P.A. Lee, S.W. Wilhelm, J. Sun, J.M. Rose, N. Nemcek, I. Benner, and D.A. Hutchins. 2009. The effects of increased pCO2 and temperature on the North Atlantic Spring Bloom: I. The phytoplankton community and biogeochemical response. Marine Ecology Progress Series 388: 13-25.

Lee, P.A., J.R. Rudisill, A.R. Neeley, D.A. Hutchins, Y. Feng, C.E. Hare, K. Leblanc, J.M. Rose, S.W. Wilhelm, J.M. Rowe, and G.R. DiTullio. 2009. The effects of increased pCO2 and temperature on the North Atlantic Spring Bloom: III. Dimethylsulfoniopropionate. Marine Ecology Progress Series 388: 41-49.

Methods & Sampling

Nanophytoplankton and picophytoplankton abundance measured by flow cytometry
Nano- and picophytoplankton were enumerated using standard flow cytometric techniques (Olson et al. 1983, Yentsch et al. 1983). Samples were removed daily directly from experimental bottles, and 2 ml were preserved with 10% formalin buffered with seawater (1% final concentration), then frozen at –80°C until analysis. Samples were analyzed in the laboratory on a Becton Dickinson FACSCalibur benchtop flow cytometer. Phytoplankton were identified in cytograms based on forward angle light scatter (size) and red fluorescence (chlorophyll). Phytoplankton were classified within cytograms as picoplankton (0.2 to 2 µm) or nanoplankton (2 to 20 µm) using 2 µm green fluorescent beads (Invitrogen) added to each sample.

References:
Olson, R.J., S.L. Frankel, S.W. Chisholm, and H.M. Shapiro. 1983. An inexpensive flow cytometer for the analysis of fluorescence signals in phytoplankton: chlorophyll and DNA distributions. Journal of Experimental Marine Biology and Ecology 68: 129-144.

Yentsch, C.M., P.K. Horan, K. Muirhead, Q. Dortch, E.M. Haugen, L. Legendre, L.S. Murphy, D. Phinney, S.A. Pomponi, R.W. Spinrad, A.M. Wood, C.S. Yentsch, and B.J. Zahurenec. 1983. Flow cytometry and sorting: a

powerful technique with potential applications in aquatic sciences. Limnology and Oceanography 28: 1275-1280.

Data Processing Description

BCO-DMO Processing Notes:

- File was sorted by treatment
- Added lat, lon values of original water sampling location to file
- Added BCO-DMO header lines
- Parameter names were edited to conform with BCO-DMO convention
- Edited abundance precision to 3 decimals as per the PI

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Data Files

File
phyto_abund.csv (Comma Separated Values (.csv), 6.94 KB) MD5:d76b3ac1e849bbc6f35779f26e9475ef Primary data file for dataset ID 3888

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Parameters

Parameter	Description	Units
treatment	Experimental conditions varied in order to observe a variable's effect. Four treatments were used: (1) 12 deg C and 390 ppm CO2 (LTLC), (2) 12 deg C and 690 ppm CO2 (LTHC), (3) 16 deg C and 390 ppm CO2 (HTLC), and (4) 16 deg C and 690 ppm CO2 (HTHC).	dimensionless
day	Sampling day during experiment. The experiment was conducted from June 20 to July 4, 2005.	dimensionless
bottle	Experimental bottle number.	dimensionless
abund_nanophyto	Total cell counts of nanophytoplankton (2 to 20 um) per milliliter of sample.	cells per ml
abund_picophyto	Total cell counts of picophytoplankton (.2 to 2 um) per milliliter of sample.	cells per ml
sample	Unique alphanumeric characters identifying each sample.	dimensionless
lat	Latitude component of geographic position where water was sampled.	decimal degrees
lon	Longitude component of geographic position where water was sampled.	decimal degrees

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Instruments

Dataset-specific Instrument Name	Flow Cytometer
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	Samples were analyzed in the laboratory on a Becton Dickinson FACSCalibur benchtop flow cytometer.
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)

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Deployments

SJ0516

Website	https://www.bco-dmo.org/deployment/57981
Platform	R/V Seward Johnson
Start Date	2005-06-03
End Date	2005-07-06
Description	This R/V Seward Johnson cruise, funded by NSF OCE/BIO (OCE-0423418), was conducted as part of the NASB 2005 US/EC Collaboration on Potential Climate Change Impacts on Algal Community Structure and Biogeochemistry During the North Atlantic Spring Bloom. It is uncertain whether a cruise ID was ever assigned. The US State Department designator was SJ-2004-126, possibly reflecting request for approval that began in 2004. The Oceanic Research Ship Schedules database (from the Ocean Information Center maintained by the College of Marine & Earth Studies at the University of Delaware) assigned JOH/05/0063 to leg 2 of this cruise. The BCO-DMO assigned SJ0516 as the unique cruise ID since leg 2 was the sixteenth cruise for R/V Seward Johnson in 2005. Cruise Synopsis adapted from the original text written by NASB 2005 project investigator Matthew Cottrell The R/V Seward Johnson departed from Fort Pierce, FL in June, 2005. The vessel first transited to the Azores (cruise leg 1, Florida to the Azores) where it spent two days before heading north to Iceland (cruise leg 2, Azores to Iceland). The purpose of this cruise was to explore the ecology of heterotrophic and photoheterotrophic bacteria in the North Atlantic. Surface waters were sampled during the transit across the oligotrophic Atlantic, passing Bermuda on the way. Depth profiles were sampled on the leg from the Azores to Iceland. Water was collected for a number of analyses. One of the most important assessed the effect of light on the growth of heterotrophic bacteria using 3H-leucine incorporation and the uptake of other organic compounds. We were especially interested in cyanobacteria, including Prochlorococcus and Synechococcus. Flow cytometery and flow sorting of radiolabeled cells was key to this project. Other analyses included bacterial abundance, bacterial production, bacterial community structure (FISH), community activity (Micro-FISH), chlorophyll a, bacterial chlorophyll a, and the abundance of aerobic anoxigenic phototrophic (AAP) bacteria.

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Project Information

North Atlantic Spring Bloom 2005 (NASB 2005)

Coverage: North Atlantic

Climate-related shifts in phytoplankton assemblages may have profound implications for oceanic feedbacks on the atmosphere, and for human use of marine resources. Particular algal groups are largely responsible for crucial processes like vertical carbon export, biogenic calcification and silicification, production of climatically active gases like dimethylsulfide (DMS), and for sustaining food webs that lead to economically valuable higher trophic levels. The North Atlantic Spring Bloom 2005 (NASB 2005) research program was designed to investigate potential climate change impacts on algal community structure and biogeochemistry during the North Atlantic Spring Bloom, a regime that is ideal for determining how changing ocean conditions may affect both calcareous and siliceous algae.

The research was coordinated with CarboOcean, a major European Union funded activity led by investigators from the Alfred Wegener Institute.

Rising climatic temperatures impact on antarctic microzooplankton growth and grazing (Antarctic microzooplankton)

Coverage: Ross Sea

The investigator will examine to what extent rising climatic temperatures impact antarctic microzooplankton growth and grazing, and to what extent such an impact would modulate top-down control of phytoplankton growth in cold waters. The experimental part of the proposed work would take place in the Ross Sea, a permanently cold ecosystem, and the location of annual large-scale blooms of both diatoms and Phaeocystis antarctica. Changing climate regimes may alter current microzooplankton grazing rates on these blooms either directly through temperature increases or indirectly through algal community shifts. Complementary laboratory experiments on cultures of Antarctic microzooplankton will be conducted to determine the individual and combined effects of temperature and carbon dioxide levels on growth and grazing.

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Funding

Funding Source	Award
NSF Antarctic Sciences (NSF ANT)	PLR-0528715

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