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

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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

The experiment was conducted onboard the RV Seward Johnson II, from June 20 to July 4, 2005, with water collected at 57 deg 58" N, 15 deg 32" W. Four treatments were used with 6 replicates each: (1) 12 deg C and 390 ppm CO_2 (LTLC), (2) 12 deg C and 690 ppm CO_2 (LTHC), (3) 16 deg C and 390 ppm CO_2 (HTLC), and (4) 16 deg 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 um 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 deg 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 um 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 um inline capsule filter initially, then re-filtered through a second 0.2 um 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 degrees 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

Microzooplankton abundance and community composition determined by light microscopy
Samples for enumeration of microzooplankton were removed from outflow collection bottles on Days 4, 9, and 14 of the experiment. Triplicate samples were counted on the initial day. Duplicate samples on Days 4 and 9 were mixed to obtain enough volume for accurate counts, yielding 3 replicates per treatment on these days. All 6 replicates were counted on the final day of the experiment. All samples were preserved with 10% acid Lugols solution and stored at room temperature in the dark until enumeration of microzooplankton in the laboratory (Throndsen 1978). Then, 100 ml of sample was settled for at least 18 h into Utermohl chambers before before counting using an inverted Zeiss Axiovert S100 microscope at 200× magnification (Utermohl 1958). Microzooplankton were identified to genus level when possible. The use of Lugol fixative obscured chl a fluorescence and rendered the distinction between phototrophic and heterotrophic dinoflagellates based on autofluorescence impossible. However, certain heterotrophic dinoflagellates such as Protoperidinium and Gyrodinium were identified based on morphology, and were thus included in the counts.

References:
Throndsen, J. 1978. Preservation and storage. In Phytoplankton manual, ed. A. Sournia, 69-74. Paris: UNESCO.

Utermohl, H. 1958. Zur Vervollkommung der quantitativen phytoplankton-methodik. Mitteilungen der Internationalen Vereinigung fur Limnologie 9: 1-38.

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
- File was transposed to serve data by taxon and abundance in columns
- In data values representing mixed sampling bottles, plus signs (+) were edited to underscores(_)

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Data Files

File
microzoo_abund_Natl.csv (Comma Separated Values (.csv), 33.39 KB) MD5:45398d07d01f49073f0d24f10e4df600 Primary data file for dataset ID 3877

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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
total_microzoo	Total microzooplankton cell count per liter of sample.	cells per liter
taxon	Genus name of identified microzooplankton (except 'nauplii', indicating life stage).	dimensionless
abundance	Total cell counts of genus per liter of sample.	cells per liter
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	Inverted Microscope
Generic Instrument Name	Inverted Microscope
Dataset-specific Description	/*-->*/ Counts were made using an inverted Zeiss Axiovert S100 microscope at 200× magnification (Utermohl 1958).
Generic Instrument Description	An inverted microscope is a microscope with its light source and condenser on the top, above the stage pointing down, while the objectives and turret are below the stage pointing up. It was invented in 1850 by J. Lawrence Smith, a faculty member of Tulane University (then named the Medical College of Louisiana). Inverted microscopes are useful for observing living cells or organisms at the bottom of a large container (e.g. a tissue culture flask) under more natural conditions than on a glass slide, as is the case with a conventional microscope. Inverted microscopes are also used in micromanipulation applications where space above the specimen is required for manipulator mechanisms and the microtools they hold, and in metallurgical applications where polished samples can be placed on top of the stage and viewed from underneath using reflecting objectives. The stage on an inverted microscope is usually fixed, and focus is adjusted by moving the objective lens along a vertical axis to bring it closer to or further from the specimen. The focus mechanism typically has a dual concentric knob for coarse and fine adjustment. Depending on the size of the microscope, four to six objective lenses of different magnifications may be fitted to a rotating turret known as a nosepiece. These microscopes may also be fitted with accessories for fitting still and video cameras, fluorescence illumination, confocal scanning and many other applications.

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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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