Table 1: Physical and chemical parameters during Calanus finmarchicus and Meganyctiphanes norvegica egg hatching experiments, 2011-2012

Website: https://www.bco-dmo.org/dataset/738447
Data Type: experimental
Version: 1
Version Date: 2018-06-13

Project
» Ocean Acidification-Category 1- Impact of ocean acidification on survival of early life stages of planktonic copepods in the genus Calanus in the northern (OA Calanus Survival)

Programs
» Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
Christensen, John P	Green Eyes LLC	Principal Investigator
Runge, Jeffrey A.	Gulf of Maine Research Institute (GMRI)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
During eggs experiments, the general conditions within the tanks were monitored using electrodes for temperature, pH and its millivolt output, salinity, and dissolved oxygen. Results are published in Preziosi et al (2017), Table 1.

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Coverage

Spatial Extent: **Lat**:43.7474 **Lon**:-69.501
Temporal Extent: 2011-05-26 - 2012-08-01

Dataset Description

During the eggs experiments, the general conditions within the tanks were monitored using electrodes for temperature, pH and its millivolt output, salinity, and dissolved oxygen. Results are published in Preziosi et al (2017), Table 1.

Methods & Sampling

The sensors were a model 55 YSI dissolved oxygen meter and an Orion Four Star pH conductivity meter using a gel-filled model number 9107WMMD pH/ATC Triode. Each instrument was calibrated according to the normal manufacturer's instructions using off the shelf calibration solutions. During and following experiment 8, the pH electrode readings appeared abnormal and are likely invalid. The electrode pH was only used as a guide for the sampling crew.

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- hid separator rows (all -99), and duplicate columns
- added columns for ISO_DateTime_local and yrday_local

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Data Files

File
table1.csv (Comma Separated Values (.csv), 31.77 KB) MD5:b44a26295294da89e56c3babc77d517d Primary data file for dataset ID 738447

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Related Publications

Preziosi, B. M., Runge, J. A., Christensen, J. P., & Jones, R. J. (2017). Effects of pH and temperature on egg hatching success of the marine planktonic copepod, Calanus finmarchicus . Marine Biology, 164(11). doi:10.1007/s00227-017-3243-5
Results

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Parameters

Parameter	Description	Units
EXPERIMENT	Number of the experiment	unitless
EVENT	Sampling or maintenance #	unitless
YEAR	Sampling date - year	year
MONTH	Sampling date - month	unitless
DAY	Sampling date - day	unitless

HR	Sampling time - hour of the day	unitless
MIN	Sampling time - minutes of the hour	unitless
TIME_elapsed	Time from internment of the eggs	hours
PURPOSE	Sampling or maintenance type	unitless
ROWTYPE	Labels of the subsequent rows	unitless
TEMP_1	Temperature of the tank	degrees Celsius
PH_1	pH in the tank	pH units
PHMV_1	mv output of the pH electrode	millivolts
SAL_1	Salinity in the tank	parts per thousand (ppt)
DO_1	Dissolved Oxygen in the tank	% saturation
TEMP_2	Temperature of the tank	degrees Celsius
PH_2	pH in the tank	pH units
PHMV_2	mv output of the pH electrode	millivolts
SAL_2	Salinity in the tank	parts per thousand (ppt)
DO_2	Dissolved Oxygen in the tank	% saturation
TEMP_3	Temperature of the tank	degrees Celsius
PH_3	pH in the tank	pH units
PHMV_3	mv output of the pH electrode	millivolts
SAL_3	Salinity in the tank	parts per thousand (ppt)

DO_3	Dissolved Oxygen in the tank	% saturation
TEMP_4	Temperature of the tank	degrees Celsius
PH_4	pH in the tank	pH units
PHMV_4	mv output of the pH electrode	millivolts
SAL_4	Salinity in the tank	parts per thousand (ppt)
DO_4	Dissolved Oxygen in the tank	% saturation
TEMP_5	Temperature of the tank	degrees Celsius
PH_5	pH in the tank	pH units
PHMV_5	mv output of the pH electrode	millivolts
SAL_5	Salinity in the tank	parts per thousand (ppt)
DO_5	Dissolved Oxygen in the tank	% saturation
COMMENTS	investigator notes	unitless
ISO_DateTime_local	ISO-formatted date and time	
yrday_local	local day and decimal time, as 326.5 for the 326th day of the year, or November 22 at 1200 hours (noon).	unitless

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Instruments

Dataset-specific Instrument Name	Orion Four Star pH conductivity meter
Generic Instrument Name	Benchtop pH Meter
Dataset-specific Description	Used with a gel-filled model number 9107WMMD pH/ATC Triode
Generic Instrument Description	An instrument consisting of an electronic voltmeter and pH-responsive electrode that gives a direct conversion of voltage differences to differences of pH at the measurement temperature. (McGraw-Hill Dictionary of Scientific and Technical Terms) This instrument does not map to the NERC instrument vocabulary term for 'pH Sensor' which measures values in the water column. Benchtop models are typically employed for stationary lab applications.

Dataset-specific Instrument Name	Orion Four Start pH conductivity meter
Generic Instrument Name	Conductivity Meter
Dataset-specific Description	Used to measure the approximate salinities.
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

Dataset-specific Instrument Name	model 55 YSI dissolved oxygen meter
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Used to measure dissolved oxygen in the experimental tanks.
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

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Project Information

Ocean Acidification-Category 1- Impact of ocean acidification on survival of early life stages of planktonic copepods in the genus Calanus in the northern (OA Calanus Survival)

Coverage: Gulf of Maine

The project description is a modification of the original NSF award abstract.

This research project is part of the larger NSF funded CRI-OA collaborative research initiative and was funded as an Ocean Acidification-Category 1, 2010 award. While attention concerning impacts of predicted acidification of the world's oceans has focused on calcifying organisms, non-calcifying plankton may also be vulnerable. In this project, the investigator will evaluate the potential for impacts of ocean acidification on the reproductive success of three species of planktonic copepods in the genus Calanus that are prominent in high

latitude oceans. *C. finmarchicus* dominates the mesozooplankton biomass across much of the coastal and deep North Atlantic Ocean. *C. glacialis* and the larger *C. hyperboreus* are among the most abundant planktonic copepods in the Arctic Ocean. Previous research showed that hatching success of *C. finmarchicus* eggs was severely inhibited by increased CO2 and lower pH in seawater, but only tested at an extreme level. Preliminary results in the investigator's laboratory indicate that hatching success of *C. finmarchicus* is substantially reduced at increased seawater CO2 concentrations corresponding to pH levels between 7.9 and 7.5. Predictions of likely decline of surface pH levels to 7.7-7.8 over the next century raise questions about impacts on Calanus population dynamics if these preliminary results are confirmed. *C. finmarchicus*, for example, is presently at the southern edge of its range in the Gulf of Maine. The combination of higher surface layer temperature and lower pH may inhibit reproductive success during the late summer/fall bloom, which the PI hypothesize is critical to sustain the overwintering stock in this region. The investigators will collect *C. finmarchicus* females from the Gulf of Maine and, with the assistance of Canadian colleagues, *C. glacialis* and *C. hyperboreus* females from the deep lower St. Lawrence Estuary. They will conduct laboratory experiments in which hatching success, development and growth of Calanus nauplius stages are measured in controls of natural seawater and at a series of treatments in which CO2 concentrations, pH and temperature are rigorously controlled to represent possible future states of the northern ocean. The investigators will measure present surface and deep pCO2 and pH across the Gulf of Maine, including its deep basins, during a research cruise. The study will evaluate the hypothesis that predicted levels of CO2 increase in the northern ocean will impact population dynamics of the Calanus species. Using the results from the research cruise and a recently developed 1-D, Individual-Based life cycle model, the PI will explore in detail scenarios of impact of higher temperature and lower surface and deep pH on population dynamics of *C. finmarchicus* in the Gulf of Maine.

The lipid-rich Calanus species are considered key intermediary links between primary production and higher trophic levels in North Atlantic and Arctic Ocean food webs. Impacts of higher surface temperature and lower pH on reproductive success may potentially lead to profound changes in energy transfer and structure of pelagic ecosystems in the northern oceans. In the Gulf of Maine, *C. finmarchicus* serves as primary prey for herring, sand lance, and mackerel, as well as the endangered northern right whale, warranting thorough evaluation of ocean acidification effects on its population dynamics.

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Program Information

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:
NSF 10-530, FY 2010-FY2011
NSF 12-500, FY 2012
NSF 12-600, FY 2013
NSF 13-586, FY 2014
NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:
1st U.S. Ocean Acidification PI Meeting(March 22-24, 2011, Woods Hole, MA)
2nd U.S. Ocean Acidification PI Meeting(Sept. 18-20, 2013, Washington, DC)
3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

NSF media releases for the Ocean Acidification Program:

Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification

Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?

Discovery nsf.gov - National Science Foundation (NSF) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation (NSF)

Press Release 12-179 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation (NSF)

Press Release 13-102 World Oceans Month Brings Mixed News for Oysters

Press Release 13-108 nsf.gov - National Science Foundation (NSF) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation (NSF)

Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants

Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation (NSF)

Press Release 14-010 nsf.gov - National Science Foundation (NSF) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation (NSF)

Press Release 14-116 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: NSF awards $11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation (NSF)

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal

and open oceans.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1041081

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