Lactate in Antarctic krill, Euphausia superba, tissue from short-term (2-day) trial #1 maintained at ambient conditions, high temperature and/or high CO2 (OA Krill project)

Website: https://www.bco-dmo.org/dataset/724539
Data Type: experimental
Version: 2
Version Date: 2018-05-03

Project
» Collaborative Research: Synergistic effects of Elevated Carbon Dioxide (CO2) and Temperature on the Metabolism, Growth, and Reproduction of Antarctic Krill (Euphausia superba) (OA Krill)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **Lat**:-64.7743 **Lon**:-64.0533

Dataset Description

This dataset includes intracellular (tissue) lactate concentrations for Antarctic krill, *Euphausia superba,* maintained at ambient and high temperature and CO2 levels over a 24 hour period.

Methods & Sampling

Capture and husbandry: Antarctic krill (*Euphausia superba*) were captured during austral summers 2013/2014 and 2014/2015. Krill were collected by net tow (2 m diameter, 1000 m mesh, non-filtering cod end)off the R/V Laurence M. Gould near the Western Antarctic Peninsula and transported directly to Palmer Research Station. One to two thousand krill were housed in one 4'wx3'h circular holding tank and two 5’x2’x1’ rectangular tanks provided with aeration and flow-through seawater. Water was non-filtered and individuals were able to feed on plankton *ad libitum* throughout the season.

Experimental treatments: Four experimental treatments were targeted in this study, (1) ambient temperature and ambient CO2, (2) ambient temperature and high CO2 (800ppm), (3) high temperature (3C) and ambient CO2 (4) high temperature and high CO2.Temperature treatments were obtained using two separate recirculating systems. One 800 L cylindrical polycarbonate carboy was attached to a temperature controlled chiller (Delta Star) and inline pump. The carboy was placed in a flow-through water bath and

maintained at 0C. A similar system was set up without a chiller and placed in an environmental chamber set at 3C. The systems were replaced with new water and allowed to acclimate to temperature 24 hours before the start of a trial or water change. High CO2 conditions were obtained using a peristaltic pump to inject straight CO2 into the propeller of a pump submerged in seawater. Treated water was then pumped with minimal disturbance into treatment buckets.

Krill of comparable size (average 1 g) were picked and placed in 19 L plastic buckets with airtight lids up to n = 20. Buckets were filled with one of the four treatment waters as described above. Buckets were immediately closed and placed in environmental chambers set to 0C or 3C. Every 24 hours 80% of the water was siphoned out and replaced to minimize excretory and respiratory effect of the animals on treatment conditions. Time points were set at time = 0, 1, 6, 12, 24, 48 hours and 7, 14, 19 days (168, 336, 456 hours). Each bucket was run in duplicate for each treatment at each time point. During season one two 48 hour experiments and three 24 hour long experiments were run. During season two one 24-hour, one 48-hour and one 19-day experiment were completed. Separate buckets were run in duplicate at 0C and 3C for TMAO analysis. For endpoint respirometry, krill were placed one at a time in 300mL airtight glass jars filled with 2um filtered treatment water. Each jar was paired with a blank containing no individuals, placed in water baths, covered, and put in 0C or 3C environmental chambers for the duration of the experiment.

Analyses: At the end of an experimental duration, blood was immediately taken from 5-10 krill using a 20 gauge needle and pooled. Blood pH was determined using a temperature controlled pH microelectrode (Microelectrodes, Inc. Bedford, NH, USA). Blood lactate was also measured using a handheld lactate meter (Roche Accutrend). The remaining 10 krill were decapitated and their bodies flash frozen for later analysis. Individual tissue (up to n=5) was weighed and homogenized in 500uL homogenate buffer containing 150 mmol L^{-1} Potassium fluoride and 5 mmol L^{-1} nitrilotriacetic acid (Portner et al., 1990). 75uL homogenate was injected into the Corning 965 total CO2 analyzer, Midland, MI, USA for TCO2 determination. Remaining homogenate was then used to measure pH using the microelectrode as described above. Alternate individuals (up to n=5) were used to measure tissue lactate. Tissue was homogenized 1:1 in DI water using 3 mL glass homogenizers on ice. The supernatant was then measured for lactate using the Accutrend lactate meter. Individuals used for TMAO determination were homogenized 1:5 in 5% trichloroacetic acid then supernatant used with the ferrous sulfate-EDTA method of TMAO determination described by Wekell and Barnett (1991). Endpoint respirometry measurements were taken using a Strathkelvin oxygen electrode and blanks used to correct for residual bacterial respiration.

Data Processing Description

BCO-DMO Processing Notes:
version 1: 2018-01-23:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- added columns for time_elapsed, treatment_temp, and treatment_CO2 which were combined in a column 'Description'
- replaced spaces with underscores in treatment_temp and treatment_CO2 column

version 2: 2018-05-03:
- added O2_consumption column

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Data Files

File	
short_term_trial.csv	(Comma Separated Values (.csv), 5.36 KB) MD5:30169c68bd5511458bfd67983c4469bb
Primary data file for dataset ID 724539	

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Parameters

Parameter	Description	Units
time_elapsed	time since start of experimental trial	time_elapsed
treatment_temp	temperature treatment; either ambient or high (3C)	unitless
treatment_CO2	CO2 treatment: either ambient or high (800 ppm)	unitless
Grinding_Buffer_Lactate_mM	concentration of lactate in the grinding (homogenizting) buffer (grinding buffer is seawater with 20 mM Tris buffer)	milliMolar (mM)
O2_consumption	mean oxygen consumption	micromoles Oxygen/gram/hr (umol O2 g-1h-1)
Weight_mg	tissue weight	milligrams (mg)
Volume_Grinding_Buffer_uL	volume of grinding buffer (grinding buffer is seawater with 20 mM Tris buffer)	microliters (uL)
Lactate_mM	lactate concentration of tissue	milliMolar (mM)
comment	other comments or notes	unitless

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Instruments

Dataset-specific Instrument Name	Delta Star chiller
Generic Instrument Name	Aquarium chiller
Dataset-specific Description	Used to cool water to ambient temperature.
Generic Instrument Description	Immersible or in-line liquid cooling device, usually with temperature control.

Dataset-specific Instrument Name	Corning 965 total CO2 analyser, Midland, MI, USA
Generic Instrument Name	CO2 Analyzer
Dataset-specific Description	Used to measure CO2 in tissues.
Generic Instrument Description	Measures atmospheric carbon dioxide (CO2) concentration.

Dataset-specific Instrument Name	
Generic Instrument Name	Homogenizer
Dataset-specific Description	Used to homogenize krill tissues.
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

Dataset-specific Instrument Name	handheld lactate meter (Roche Accutrend)
Generic Instrument Name	Optode
Dataset-specific Description	Used to measure lactate concentrations in krill blood and tissue.
Generic Instrument Description	An optode or optrode is an optical sensor device that optically measures a specific substance usually with the aid of a chemical transducer.

Dataset-specific Instrument Name	
Generic Instrument Name	Plankton Net
Dataset-specific Description	Net with 2 m diameter, 1000 m mesh, non-filtering cod end. Used to collected krill for experimental analyses.
Generic Instrument Description	A Plankton Net is a generic term for a sampling net that is used to collect plankton. It is used only when detailed instrument documentation is not available.

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Project Information

Collaborative Research: Synergistic effects of Elevated Carbon Dioxide (CO2) and Temperature on the Metabolism, Growth, and Reproduction of Antarctic Krill (Euphausia superba) (OA Krill)

Website: http://coseenow.net/project-parka/

Coverage: Palmer Station, Antarctica

NSF Award Abstract:
Climate change projections for this century suggest that the Southern Ocean will be the first region to be affected by seawater chemistry changes associated with enhanced carbon dioxide (CO2). Additionally, regions of the Southern Ocean are warming faster than any other locations on the planet. Ocean acidification and warming may act synergistically to impair the performance of different organisms by simultaneously increasing metabolic needs and reducing oxygen transport. However, no studies have measured krill acid-base regulation, metabolism, growth, or reproduction in the context of ocean acidification or synergistic ?greenhouse? conditions of elevated CO2 and temperature. In the present project, the investigators will conduct both short and prolonged exposure experiments at Palmer Station, Antarctica to determine the responses of Euphausia superba to elevated CO2 and temperature. The investigators will test hypotheses related to acid-base compensation and acclimation of various life stages of krill to elevated CO2 and temperature. Furthermore, they will determine these impacts on feeding, respiration, metabolism, growth, and reproduction.

The Antarctic krill, Euphausia superba, is a key species in Antarctic food webs as they are a primary food source for many of the top predators in the Southern Ocean including baleen whales, seals, penguins, and other sea birds. This project will determine the responses of Antarctic krill exposed to elevated CO2 and temperature and whether or not krill have the capacity to fully compensate under future ocean conditions. The proposed field effort will be complemented by an extensive broader impact effort focused on bringing marine science to both rural and urban high school students in the Midwest (Kansas). The core educational objectives of this proposal are to 1) instruct students about potential careers in marine science, 2) engage students and promote their interest in the scientific process, critical thinking, and applications of science, mathematics, and technology, and 3) and increase student and teacher awareness and understanding of the oceans and global climate change, with special focus on the Western Antarctic Peninsula region. Finally, this project will engage undergraduate and graduate students in the production, analysis, presentation and publication of datasets.

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Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1641198

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