Grazing rates of Euphausia crystallorophias from RVIB Nathaniel B. Palmer NBP1801 in the Ross Sea, Jan.-Feb. 2018

Website: https://www.bco-dmo.org/dataset/792478
Data Type: experimental
Version: 1
Version Date: 2020-02-10

Project
» Using Bio-acoustics on an Autonomous Surveying Platform for the Examination of Phytoplankton-zooplankton and Fish Interactions in the Western Ross Sea (bio-acoustic plankton surveys)

Contributors	Affiliation	Role
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Abstract
Four experiments using the gut fluorescence/gut evacuation technique were conducted during the R/V Nathaniel B. Palmer cruise NBP1801 in Jan-Feb 2018 to determine grazing rates of crystal krill, Euphausia crystallorophias.

Table of Contents

- Coverage
- Dataset Description
  - Acquisition Description
  - Processing Description
- Parameters
- Instruments
- Deployments
- Project Information
- Funding

Coverage

Spatial Extent: **N**:-74.7903 **E**:172.9985 **S**:-76.7504 **W**:164.1588
Temporal Extent: 2018-01-10 - 2018-02-16

Dataset Description

Four experiments using the gut fluorescence/gut evacuation technique were conducted during the R/V Nathaniel B. Palmer cruise NBP1801 in Jan-Feb 2018 to determine grazing rates of crystal krill, Euphausia crystallorophias.

Acquisition Description

Sample collection: Mid-water trawls were conducted in the western Ross Sea, Antarctica on board the R/V Nathaniel B. Palmer in January-February 2018 (cruise number 18-01). The Issacs-Kidd Midwater Trawl (IKMT, 1.8 m frame, 500 um mesh, non-filtering cod end) was fitted with a calibrated General Oceanics flow meter. Four trawls were completed, each used to conduct a grazing experiment using the gut fluorescence/gut evacuation technique. Sampling stations for experiments 1-3 were located on the Continental Shelf Adjacent to the Ross Ice Shelf barrier near 76ºS, and experiment 4 was located on the continental shelf near 74ºS.

Experiment 1 date and location: 1/16/2018; -76 00.044S, 176 59.909E
Experiment 2 date and location: 1/18/2018; -76 45.024S, 172 01.733E
Experiment 3 date and location: 2/6/2018; -76 27.063S, 168 07.142E
Experiment 4 date and location: 2/16/2018; -74 49.955S, 164 34.177E

Experimental Procedure: Immediately after each trawl (for each experiment), a subset of crystal krill, Euphausia crystallorophias, were processed for initial gut fluorescence and the other krill were sorted into experimental buckets for a time series sample collection. The krill collected for initial gut fluorescence were immediately measured for length, wrapped in foil, flash frozen in liquid nitrogen, and placed in a -80ºC freezer for later chlorophyll gut content analysis (see below). To determine gut evacuation rates, an additional 5 krill were processed immediately after collection for the initial time point, T0. The remaining krill were quickly sorted into five buckets to achieve a total of 12 krill per bucket. Each bucket was filled with 15L of 0.2µm filtered seawater, and 4.0 mg of activated granular charcoal powder was added at a final concentration of 265 µg L-1. The filtered seawater was maintained at in situ temperature in a cold incubator room for the duration of the 24-hr experiment. One krill per bucket was removed at time points of 5, 10, 15, 20, 25, 30, 40, 50, 60, and 120 minutes, yielding a sample size of five krill per time point. Finally, 1-2 krill were removed after 24 hours to obtain background gut fluorescence which is to be subtracted from all the other krill fluorescence samples. All krill removed at each time point were measured for standard length, wrapped in foil, flash frozen in liquid nitrogen, and placed in the -80ºC freezer.

Analyses: Fluorometric analysis was then conducted on the krill samples using a Turner 10-AU Fluorometer before and after acidification. The analysis was performed in the dark to ensure that chlorophyll did not degrade during sample preparation and processing. Each krill was placed without homogenization into a 20mL glass scintillation vial where 5ml of 90% acetone was added to extract chlorophyll pigments. The samples were covered in foil and placed into the -20 ºC freezer for a 48-hr extraction. After this extraction period, the samples along with 3 prepared blanks of 5ml acetone were transferred to individual sample cuvettes. Each sample was placed in the fluorometer to obtain fluorescence values before acidification. The sample was then removed from the fluorometer, 2 drops of 1.2M hydrochloric acid was added, and the sample was placed back into the fluorometer to obtain values after acidification.

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
- changed negative value for krill#49 chl-a to 0 (was -0.003, rounded to -0.0)

[table of contents | back to top]

Parameters

Parameter	Description	Units
Measurement	The measurement as part of the gut fluorescence/gut evacuation technique that the final chlorophyll and phaeopigment data will be used for in calculations of krill grazing	unitless
Krill_number	Sequential number of krill used for each measurement component of the gut fluorescence/gut evacuation technique	unitless
Time_Interval_minutes	Time interval during each grazing experiment whereby krill were removed from replicate buckets and processed for gut fluorescence	minutes

Bucket_number	Bucket number that indicates where krill were removed at specific intervals during each grazing experiment. There were five replicate buckets; each with 12 krill during each experiment	unitless
E1_Krill_length_mm	Experiment 1: standard length of individual krill (anterior tip of the rostrum to posterior tip of the uropod) measured with digital calipers from the experiments that were ultimately processed for gut fluorescence	mm = millimeters
E1_Chlorophyll_a_ug_L	Experiment 1: chlorophyll a concentration of individual krill measured with a Turner 10-AU fluorometer	ug/L = micrograms per liter
E1_Phaeopigment_ug_L	Experiment 1: phaeopigment concentration of individual krill measured with a Turner 10-AU fluorometer after addition of hydrochloric acid	ug/L = micrograms per liter
E2_Krill_length_mm	Experiment 2: standard length of individual krill (anterior tip of the rostrum to posterior tip of the uropod) measured with digital calipers from the experiments that were ultimately processed for gut fluorescence	mm = millimeters
E2_Chlorophyll_a_ug_L	Experiment 2: chlorophyll a concentration of individual krill measured with a Turner 10-AU fluorometer	ug/L = micrograms per liter
E2_Phaeopigment_ug_L	Experiment 2: phaeopigment concentration of individual krill measured with a Turner 10-AU fluorometer after addition of hydrochloric acid	ug/L = micrograms per liter
E3_Krill_length_mm	Experiment 3: standard length of individual krill (anterior tip of the rostrum to posterior tip of the uropod) measured with digital calipers from the experiments that were ultimately processed for gut fluorescence	mm = millimeters
E3_Chlorophyll_a_ug_L	Experiment 3: chlorophyll a concentration of individual krill measured with a Turner 10-AU fluorometer	ug/L = micrograms per liter

E3_Phaeopigment_ug_L	Experiment 3: phaeopigment concentration of individual krill measured with a Turner 10-AU fluorometer after addition of hydrochloric acid	ug/L = micrograms per liter
E4_Krill_length_mm	Experiment 4: standard length of individual krill (anterior tip of the rostrum to posterior tip of the uropod) measured with digital calipers from the experiments that were ultimately processed for gut fluorescence	mm = millimeters
E4_Chlorophyll_a_ug_L	Experiment 4: chlorophyll a concentration of individual krill measured with a Turner 10-AU fluorometer	ug/L = micrograms per liter
E4_Phaeopigment_ug_L	Experiment 4: phaeopigment concentration of individual krill measured with a Turner 10-AU fluorometer after addition of hydrochloric acid	ug/L = micrograms per liter

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Turner 10-AU fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Device used specifically to detect chlorophyll fluorescence emission from each krill sample. Used to calculate krill gut fluorescence.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Isaacs-Kid Midwater Trawl
Generic Instrument Name	Isaacs-Kidd Midwater Trawl
Dataset-specific Description	Rectangle framed net (1.75 m x 1.44 m) with 500 um mesh and a non-filtering cod end. Used to collected zooplankton during the Ross Sea cruise.
Generic Instrument Description	A trawl with a pentagonal mouth opening and a dihedral depressor vane as part of the mouth opening. IKMTs come in various dimensions (refer to individual dataset documentation). The original IKMTs were 10 foot (304 cm) and 15 foot (457 cm) at the mouth. The 10 foot IKMT net was 31 feet (9.45 m) in length (Wiebe and Benfield 2003).

[table of contents | back to top]

Deployments

NBP1801

Website	https://www.bco-dmo.org/deployment/778919
Platform	RVIB Nathaniel B. Palmer
Start Date	2017-12-16
End Date	2018-03-03
Description	Chief Scientist: Saba, Grace Start Port: Punta Arenas End Port: Hobart

[table of contents | back to top]

Project Information

Using Bio-acoustics on an Autonomous Surveying Platform for the Examination of Phytoplankton-zooplankton and Fish Interactions in the Western Ross Sea (bio-acoustic plankton surveys)

Coverage: Terra Nova Bay, Western Ross Sea, Antarctica

NSF Award Abstract: The Ross Sea is the one of the most productive regions in Antarctica and supports large populations of several key species in the Ross Sea food web, including copepods, crystal krill (Euphausia crystallorophias), and Antarctic silverfish (Pleuragramma antarcticum). Copepods and crystal krill dominate the diets of Antarctic silverfish, the dominant fish species in the high Antarctic zone, and silverfish are a major link between lower (copepods, krill) and higher (fishes, marine mammals, flighted birds, Adélie and Emperor penguins) trophic levels. Despite the significance of these key species, there is limited understanding of copepod, krill, and silverfish mesoscale distribution, spatial structure of age/maturity classes, and their interactions with physical drivers within the Ross Sea. Autonomous underwater profiling gliders are a developing technology that offers the potential for providing high spatial, temporal, and depth resolution data on regional scales. The project will test the capability of a multi-frequency echo sounder integrated into a Slocum Webb glider with the aim of providing the first glider-based acoustic assessment of simultaneous distributions of three trophic levels in the Ross Sea. Complementary glider sensors measuring physical, chemical, and biological parameters will provide mesoscale and sub-mesoscale hydrographic information from which phytoplankton-zooplankton-fish interactions and the relationships between these organisms and physics drivers (sea ice, circulation features) will be investigated. The approach proposed here, glider acoustics, is relatively new and has the potential to be transformational for investigating food webs and the Ross Sea ecosystem. Researchers will modify and integrate an Acoustic Zooplankton and Fish Profiler (AZFP) multi-frequency echo sounder into a Slocum Webb G2 glider with the capability to differentiate between krill and other types of zooplankton, including copepods, and different sizes of krill and silverfish. The AZFP will be complemented with the existing glider sensors including a CTD, a WET Labs BB2FL ECO puck configured for simultaneous chlorophyll fluorescence (phytoplankton biomass) and optical backscatter measurements, and an Aanderaa Optode for measuring dissolved oxygen. The new sensor suite will be tested during a four-week glider deployment, where it will conduct acoustic surveys to map distribution and abundance of multiple zooplankton taxa and silverfish during the austral summer along the Terra Nova Bay polynya ice shelf and in adjacent continental shelf waters. The relationships between phytoplankton-zooplankton-fish distributions and the physical drivers of zooplankton and silverfish species and size distributions will be investigated. Coordinated ship-based acoustic sampling and net tows/trawls will be conducted multiple times during the glider deployment to validate glider acoustic-based species, size, and abundance measurements. Open accessible, automated data produced during this project will be made available through RUCOOL (Rutgers University Center for Ocean Observing Leadership) and THREDDS (Thematic Real-time Environmental Data Distribution System). The production of consistent, vertically-resolved, high resolution glider-based acoustic measurements will define a successful outcome of this

project that should help in identifying the challenges in their use as a potentially cost-effective, automated examination of food webs in the Antarctic.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1743035

[table of contents | back to top]