Grainsize, carbon, and nitrogen from sediment cores collected from 17 sites in McMurdo Sound, Antarctica from 2002 to 2014

Website: https://www.bco-dmo.org/dataset/746035
Data Type: Other Field Results
Version: 1
Version Date: 2018-10-01

Project
» Decadal Variation in Antarctic Marine Benthic Ecosystems (McMurdo Marine Benthos)
» Food web dynamics in an intact ecosystem: the role of top predators in McMurdo Sound (McMurdo Predator Prey)
» Development of a Remotely Operated Vehicle for Under Sea Ice Research in Polar Environments (SCINI)
» Community Dynamics in a Polar Ecosystem: Benthic Recovery From A Large Scale Organic Enrichment in the Antarctic (Antarctic Benthic Recovery)

Contributors	Affiliation	Role
Kim, Stacy	Moss Landing Marine Laboratories (MLML)	Principal Investigator, Contact
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Sediment cores were collected by SCUBA divers during the austral spring between September and November each year from 2002 to 2014 in McMurdo Sound, Antarctica. Samples were analyzed for grainsize, carbon, and nitrogen.

Table of Contents

Coverage

Spatial Extent: **N**:-77.5283 **E**:166.77 **S**:-77.9317 **W**:163.1683
Temporal Extent: 2002 - 2014

Dataset Description

Related datasets:
McMurdo epifauna: https://www.bco-dmo.org/dataset/745874
McMurdo epifauna species list: https://www.bco-dmo.org/dataset/746999

Methods & Sampling

Samples were collected by SCUBA divers during the austral spring between September and November each year. Organisms identified in colocated images can be found in the dataset "McMurdo epifauna" https://www.bco-dmo.org/dataset/745874.

Two 4 cm diameter, 5 cm deep cores were collected, one for grainsize analysis which was refrigerated until

processing, and one for carbon and nitrogen analysis that was frozen until analysis. Sediment grainsize analyses were carried out with a Beckman-Coulter LS 13 320 laser particle size analyzer attached to an aqueous module equipped with a pump and a built-in ultrasound unit. The measured size distributions were analyzed from 0.04 µm to 2 mm. Measurements of such a wide particle size range are possible because the particle sizer is composed of two units: a laser beam for conventional (Fraunhofer) diffraction (from 0.4 µm to 2 mm) and a polarized intensity differential scatter (PIDS) unit, which measures particles based on the Mie theory of light scattering (0.04 µm; Beckman Coulter Inc., 2003). The sediment samples were dispersed in de-ionized water, and increasing amounts of the sediment solution were added to the aqueous module of the particle sizer until obscuration values of 8%–12% and PIDS obscuration values of 48%–52% were obtained. Data interpolation and statistical analyses were obtained with the laser particle sizer proprietary software (Beckman Coulter Inc., 2003). Because all samples analyzed tend to log-normal grain size distributions in the 0.04 µm to 2 mm spectrum, geometric rather than arithmetic statistics were applied to the values obtained by the logarithmically spaced size channels of the particle sizer. For total organic carbon and nitrogen analysis, frozen samples were thawed at room temperature, stirred, and approximately 5 g equivalent dry weight subsample treated with 5-10 ml 0.5-1.0 M reagent grade H2SO4 as needed to remove all inorganic carbon. Samples were then dried at 60-70°C, visually inspected to ensure complete removal of any carbonate shell fragments, and homogenized in a ball-mill. A modification of the high temperature combustion method, utilizing a Wheatstone bridge current differential, was used in a 440 Elemental Analyzer (Control Equipment Co.). Combustion was at <800°C, below the CaCO3 decomposition temperature. The manufacturers-suggested procedures were followed on duplicate or triplicate 5-10 mg aliquots, with sample variance >10% leading to re-homogenizing and re-running analysis. Calibration was with known standards using Acetanilide or L-Cystine every 20-30 machine sample runs, with ±2% acceptable limits, and detection limits were 0.2 µg/mg carbon and 0.01 µg/mg nitrogen, dry weight. Quality control was maintained by analysis of National Research Council of Canada Marine Sediment Reference Material BCSS-1 at the beginning and end of each sample analysis set. All analyzed values were within the suggested criteria of ±0.09% carbon, ±0.008% nitrogen. NA values indicate data not available. ND indicates Not Detected.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* data transposed (rows to columns)
* latitude and longitude changed from degrees decimal minutes to decimal degrees due to unsupported character restrictions in the bco-dmo system.
* blank values changed to NA for not available because any blank values imported into the BCO-DMO system would be changed to "nd" meaning "no data" and would possibly not be distinguishable from data submitter's code for not detectable "ND."

[table of contents | back to top]

Data Files

File
sediment.csv (Comma Separated Values (.csv), 13.57 KB) MD5:23b866e8fb42ee361b03695a0d20be32 Primary data file for dataset ID 746035

[table of contents | back to top]

Parameters

Parameter	Description	Units
year	Year of sample collection	unitless
site	Site name	unitless
lat_dd	Latitude	decimal degrees
lon_dd	Longitude	decimal degrees
C	total organic carbon	percent (%)
N	total nitrogen	percent (%)
mean_grainsize	mean grainsize	micrometers (µm)
median_grainsize	median grainsize	micrometers (µm)
skewness	symmetry of the grainsize distribution	unitless
kurtosis	peakedness of the grainsize distribution	unitless
mode_grainsize	mode grainsize	micrometers (µm)
sd_grainsize	standard deviation of mean grainsize	micrometers (µm)
variance_grainsize	variance of mean grainsize	micrometers (µm)
fraction_lt_63	percent of the sediment that had a grainsize smaller than 63 µm	percent (%)
fraction_64_to_500	percent of the sediment that had a grainsize between 64 and 500 µm	percent (%)
fraction_gt_500	percent of the sediment that had a grainsize greater than 500 µm	percent (%)

[table of contents | back to top]

Deployments

McMurdo_epifauna_2002-2014

Website	https://www.bco-dmo.org/deployment/746177
Platform	McMurdo Station

[table of contents | back to top]

Project Information

Decadal Variation in Antarctic Marine Benthic Ecosystems (McMurdo Marine Benthos)

Website: http://iceaged2010.mlml.calstate.edu/

Coverage: Western Antarctic

From proposal abstract:

The ability to document and understand long-term trends in ocean climate and ecology, including the role of human activities on the biosphere, depends on an adequate knowledge of natural interdecadal fluctuations. The proposed research will document changes in benthic ecosystems in McMurdo Sound over the last four decades, i.e., since the beginning of quantitative studies of population and community organization in this region. The investigators will retrieve, analyze, and archive historical data of benthic assemblages in both hard and soft substrata, and continue work on several time series projects begun in the mid-1960s and early 1970s. The investigators will focus on the succession of marine invertebrate communities that have settled and survived on a variety of artificial substrates placed on the sea floor from the late 1960s to 1989. The substrates harbor several decades of information on patterns of settlement, growth, survival, longevity, overgrowth and other biological interactions and processes. The original researchers will relocate and permanently mark (with GPS) historical sampling sites; recover data from as much of the historical work as possible; provide meta-data to insure that past data are understood and sites can be properly resampled; and make all data available to the general science community in a permanent database housed at SCAR-MarBIN. The proposed work will be closely coordinated with an international macroecology program in the Ross Sea, represented by collaborator Simon Thrush (Latitudinal Gradient Project). In addition to reporting results in peer-reviewed publications and providing research support and opportunities for at least two graduate students, the investigators also will involve undergraduate and high school interns in the project, and participate in teacher education programs. The investigators will continue ongoing collaborations with K-12 outreach and college programs that focus on ocean science, and develop a new, broader public outreach effort with the Birch Aquarium at Scripps Institution of Oceanography.

Food web dynamics in an intact ecosystem: the role of top predators in McMurdo Sound (McMurdo Predator Prey)

Website: https://scini-penguin.mlml.calstate.edu/pauls-wordpress-test-site/

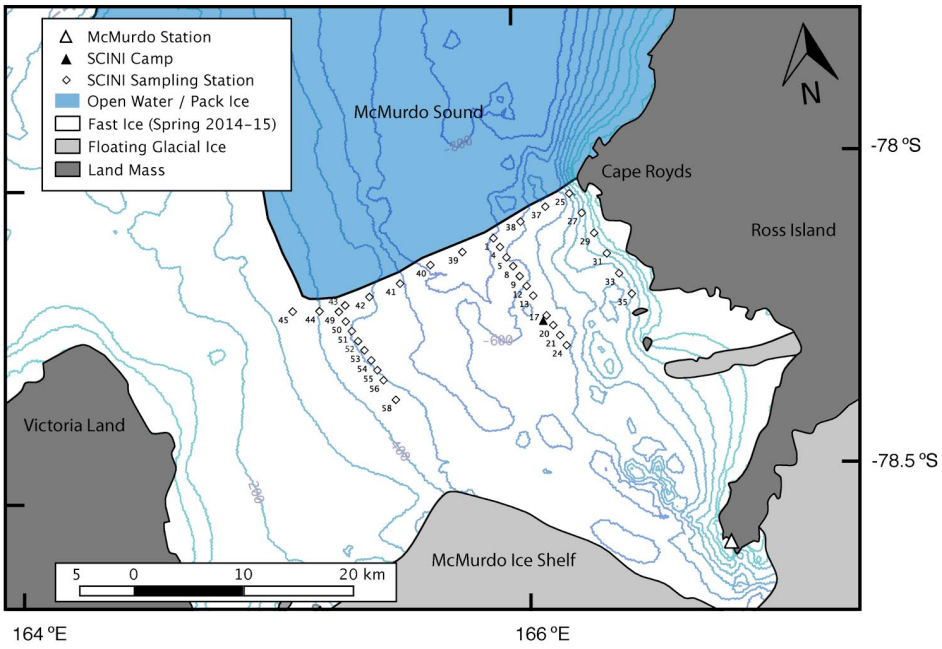
Coverage: McMurdo Sound, Antarctica

Extracted from the NSF award abstract:

The research project investigates the importance of top down forcing on pelagic food webs. The relatively pristine Ross Sea includes large populations of upper-level predators such as minke and killer whales, Adélie and Emperor penguins, and Antarctic toothfish. This project focuses on food web interactions of Adélie penguins, minke whales, and the fish-eating Ross Sea killer whales, all of which exert foraging pressure on their main prey, crystal krill (*Euphausia cyrstallorophias*) and silver fish (*Pleuragramma antarcticum*) in McMurdo Sound.

The investigators used a video- and acoustic-capable ROV, and standard biological and environmental sensors to quantify the abundance and distribution of phytoplankton, sea ice biota, prey, and relevant habitat data. The sampling area included 37 stations across an 30 x 15 km section of McMurdo Sound, stratified by distance from the ice edge as a proxy for air-breathing predator access. This study will be among the first to assess top-down forcing in the Ross Sea ecosystem and will form the basis for multidisciplinary studies in the future.

Map sampling stations



Development of a Remotely Operated Vehicle for Under Sea Ice Research in Polar Environments (SCINI)

Coverage: McMurdo Sound, McMurdo Ice Shelf

NSF Award Abstract:
In marine habitats worldwide, the zone between scuba-diving depths (to 40 m) and surge-free depths (below 200 m) has been poorly studied. Under ice-covered seas, wave motion is minimal to nonexistent, and the zone between 40 and 200 m is accessible to ROVs. Polar marine research has the benefit of stable sea ice platforms for staging and deploying instruments like ROVs, but this requires a hole that is, fo rmost ROVs, a meter in diameter. This proposal develops an ROV that can be deployed through a 15 cm hole that can be drilled with a hand-held power head, requiring minimal logistical support and technical expertise. The new ROV provides access to regions that remain unstudied, expanding our scientific reach and ability to address new questions. We will develop, test, and modify the ROV while accomplishing several overlapping and interdependent science objectives, including (1) exploration and documentation of rates and patterns of ecological succession from one of the most extreme coastal habitats in the world, (2) a survey of two unique benthic habitats and communities beyond scuba diving depths (at 40-170 m), which are almost completely unknown to most researchers and assembly of individual photographs into high-resolution images of the seafloor and (3) testing of protocols for conducting sonar mapping and creating high resolution continuous bathymetric maps of the entire seafloor around McMurdo Station. The ROV will be constructed as modules; this allows flexibility to change the ROV capabilities to suit different missions. Some components can be purchased off the shelf (e.g. VideoRay high resolution and low light video cameras), but may require development of some custom integration software. Power is provided from the surface via a 2 conductor tether; bi-directional high speed data is modulated on the tether as well, providing 84 mbs of data and unlimited dive duration. The topside controls consist of a laptop computer and joystick for the pilot. Many of the control functions and display screens could be accessed via the Internet for educational demonstrations and interactions. Two graduate students will participate fully in the project. Several other Antarctic scientists have indicated a strong interest in utilizing this tool in their research and it will be available to a pool of users on completion of the project.

Community Dynamics in a Polar Ecosystem: Benthic Recovery From A Large Scale Organic Enrichment in the Antarctic (Antarctic Benthic Recovery)

Coverage: Antarctic

NSF abstract:
Antarctic marine ecosystems differ from other polar, temperate and tropical systems at the level of individuals, populations and communities. The environment is characterized by extreme seasonality in light and food availability, along with cold stenothermal conditions. Additionally, human impacts are more limited in Antarctica than in highly populated or exploited areas. A unique research opportunity will occur in 2003 with the installation of a sewage treatment plant at McMurdo Station. This will allow for the conduct of a large-scale experiment on community recovery from organic enrichment and physical disturbance. This research will test whether major hypotheses related to community structure and disturbance recovery, which were formulated and demonstrated in more accessible marine communities, applies to Antarctic ecosystems. This research will build on a ten-year time-series that follows benthic community degradation resulting from emplacement of a sewage outfall. A complicating factor in the local McMurdo ecosystem is the input of fecal matter from the abundant populations of marine mammals and large fishes. Sampling will span the implementation of sewage treatment and the data will be incorporated in a meta-analysis of community recovery from organic disturbance in a variety of habitats, to test the generality of recovery patterns. Experimental manipulations will compare the potentially complex roles of burial and patch size in recovery dynamics. The knowledge gained from this research can be applied to other examples of high organic loading in polar habitats. Significant anthropogenic inputs in high latitudes include pulp mills and increases in human occupation and visitation as well as natural sources including woody debris in river outputs and carcass-falls from the productive surface waters above also present significant carbon inputs to high latitude environments. This study will significantly further the understanding of anthropogenic impacts in polar environments using an integrated approach to evaluate the recovery of the infaunal and epifaunal assemblages after a substantial carbon-loading perturbation sustained over ten years.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Antarctic Sciences (NSF ANT)	ANT-0842064
NSF Division of Polar Programs (NSF PLR)	PLR-0944511
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	PLR-0619622
NSF Division of Polar Programs (NSF PLR)	PLR-0126319

[table of contents | back to top]