Sea urchin biomass at central and western Aleutian Islands, Alaska from visual surveys, July 2014

Website: https://www.bco-dmo.org/dataset/755155
Data Type: Cruise Results
Version: 1
Version Date: 2019-01-30

Project
» Ocean Acidification: Century Scale Impacts to Ecosystem Structure and Function of Aleutian Kelp Forests (OA Kelp Forest Function)

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

Contributors	Affiliation	Role
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Abstract
Sea urchin biomass at central and western Aleutian Islands, Alaska from visual surveys, July 2014. Estimates were derived from visual surveys, performed via SCUBA.

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Coverage

Spatial Extent: **N**:52.91344 **E**:-176.61505 **S**:51.88707 **W**:173.30659
Temporal Extent: 2014-07-04 - 2014-07-17

Methods & Sampling

We characterized the ecological status of each island by quantifying the density, size frequency distribution, and biomass of the sea urchin community (primarily *Strongylocentrotus polyacanthus*) at randomly selected sites, using the same methods that have been employed by us and others over the past 30 years (Estes et al. 2010). Originally, we identified potential study sites by laying a grid over a map of each island, marking every place a grid line intersected the coast; these marks were later assigned GPS waypoints. During the 2014 research cruise, we randomly selected and resampled six sites per island, or in the Semichi Islands (Alaid, Nizki, and Shemya)—island group—as this level of sampling is sufficient to determine the ecological status of an island (Estes et al. 2010). We performed identical community surveys at the sites we studied with respect to algal reef bioerosion (see associated metadata forms and datasets).

At each site, a diver placed a 0.25-m^2 quadrat at 20 feet depth and counted all urchins within the quadrat, then collected the urchins in a bag. The diver then took a random number of kicks along the same depth contour and repeated this process until 20 quadrats were sampled or 200 urchins were collected, whichever occurred first. If 200 urchins were collected quickly, additional density counts were made to yield a better density estimate (n = 4 minimum). Shipside, we measured the size (test diameter; mm) of each collected urchin with calipers. We then calculated its biomass using a known size-weight relationship (Estes et al. 2010). To estimate total urchin biomass for a site (grams per 0.25-m^2), we summed the biomass of all urchins collected at the site and divided that sum by the number of quadrats deployed.

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
- re-formatted date from m/d/yyyy to yyyy-mm-dd
- reduced precision from 9 decimal places to 5 for biomass_convert and sum_biomass_class and from 9 to 3 places for urchin_biomass_grams

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Data Files

File
island_biomass.csv (Comma Separated Values (.csv), 116.33 KB) MD5:db74ae3d3a97a47250e32c2892b10ece Primary data file for dataset ID 755155

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Related Publications

Estes, J. A., Tinker, M. T., & Bodkin, J. L. (2010). Using Ecological Function to Develop Recovery Criteria for Depleted Species: Sea Otters and Kelp Forests in the Aleutian Archipelago. Conservation Biology, 24(3), 852–860. doi:10.1111/j.1523-1739.2009.01428.x
Methods

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Parameters

Parameter	Description	Units
island	name of island	unitless
site_name	identity of site	unitless
latitude	latitude of study site	decimal degrees
longitude	longitude of study site	decimal degrees
depth_feet	depth of benthic survey	feet
date	calendar date of survey formatted as yyyy-mm-dd	unitless
observer	last name of observer	unitless
quadrat_count	number of 0.25-m^2 quadrats from which estimates were derived	quadrats
urchin_diameter_mm	diameter of urchin test (body)	millimeters
urchin_frequency	number of urchins collected within a size class	urchins
size_biomass_convert	urchin biomass; calculated using known size to dry weight relationship: =EXP(-7.857+(2.992*LN(urchin diameter)))	grams
sum_biomass_class	total biomass of all urchins collected within a given size class	grams
urchin_biomass_grams	urchin biomass per 0.25 m^2 per size class; calculated by dividing "sum.biomass.class" by "quadrat.count"	grams

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Deployments

PS1409

Website	https://www.bco-dmo.org/deployment/755184
Platform	R/V Point Sur
Start Date	2014-07-05
End Date	2014-07-22
Description	Benthic community studies associated with project "Project: Ocean Acidification: Century Scale Impacts to Ecosystem Structure and Function of Aleutian Kelp Forests".

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Project Information

Ocean Acidification: Century Scale Impacts to Ecosystem Structure and Function of Aleutian Kelp Forests (OA Kelp Forest Function)

Extracted from the NSF award abstract:

Marine calcifying organisms are most at risk to rapid ocean acidification (OA) in cold-water ecosystems. The investigators propose to determine if a globally unique and widespread calcareous alga in Alaska's Aleutian archipelago, *Clathromorphum nereostratum*, is threatened with extinction due to the combined effects of OA and food web alterations. *C. nereostratum* is a slow growing coralline alga that can live to at least 2000 years. It accretes massive 'bioherms' that dominate the regions' rocky substrate both under kelp forests and deforested sea urchin barrens. It develops growth bands (similar to tree rings) in its calcareous skeleton, which effectively record its annual calcification rate over centuries. Pilot data suggest the skeletal density of *C. nereostratum* began to decline precipitously in the 1990's in some parts of the Aleutian archipelago. The

investigators now propose to use high-resolution microscopy and microCT imaging to examine how the growth and skeletal density of *C. nereostratum* has changed in the past 300 years (i.e., since the industrial revolution) across the western Aleutians. They will compare their records of algal skeletal densities and their variation through time with reconstructions of past climate to infer causes of change. In addition, the investigators will examine whether the alga's defense against grazing by sea urchins is compromised by ongoing ocean acidification. The investigators will survey the extent of *C. nereostratum* bioerosion occurring at 10 sites spanning the western Aleutians, both inside and outside of kelp forests. At each site they will compare these patterns to observed and monitored ecosystem trophic structure and recent *C. nereostratum* calcification rates. Field observations will be combined with laboratory experiments to determine if it is a decline in the alga's skeletal density (due to recent OA and warming), an increase in grazing intensity (due to recent trophic-level dysfunction), or their interactive effects that are likely responsible for bioerosion patterns inside vs. outside of forests. By sampling *C. nereostratum* inside and outside of forests, they will determine if kelp forests locally increase pH via photosynthesis, and thus buffer the effects of OA on coralline calcification. The combination of field observations with laboratory controlled experiments, manipulating CO2 and temperature, will help elucidate drivers of calcification and project how these species interactions will likely change in the near future. The project will provide the first in situ example of how ongoing ocean acidification is affecting the physiology of long-lived, carbonate producing organisms in the subarctic North Pacific. It will also be one of the first studies to document whether OA, ocean warming, and food web changes to ecological processes are interacting in complex ways to reshape the outcome of species interactions in nature.

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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)

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Funding

Funding Source	Award
NSF Arctic Sciences (NSF ARC)	PLR-1316141

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