Linear extension measurements of species from two common morphotypes of coralline algae found in Sitka Sound, AK. from 2017 - 2019 (High latitude kelp dynamics project)

Website: https://www.bco-dmo.org/dataset/857147
Data Type: Other Field Results
Version: 1
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Project
» CAREER: Energy fluxes and community stability in a dynamic, high-latitude kelp ecosystem (High latitude kelp dynamics)

Contributors	Affiliation	Role
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Abstract
This data represents in-situ seasonal changes in coralline algae growth rates. Algal individuals were collected from a crustose coralline algal genus and a geniculate coralline species from a subtidal rocky reef directly adjacent to Harris Is., Sitka Sound, AK in December 2017, July 2018, and January 2019. Crustose individuals targeted for collection were those that had a morphology that could easily be separated from the rocky substrate, often disc-shaped with distinct white growing edges. To measure linear growth, the coralline algae were imaged using a fluorescent lamp channel on a Ziess AxioZoom microscope at the UCSC Microscopy Center.

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Coverage

Spatial Extent: **N**:57.032 **E**:-135.273 **S**:57.032 **W**:-135.277
Temporal Extent: 2017 - 2019

Dataset Description

Linear extension measurements of species from two common morphotypes of coralline algae found in Sitka Sound, AK.

Methods & Sampling

Methodology:

Sampling and analytical procedures: To assess in-situ seasonal changes in coralline algae growth rates, we collected individuals from a crustose coralline algal genus (Crusticorallina painei, C. adhaerens and C. muricata; n=40) and a geniculate coralline species (Bossiella orbigniana; n=40) from a subtidal rocky reef directly adjacent to Harris Is., Sitka Sound, AK (57.032N, 135.273W) in December 2017, July 2018, and January 2019. Crustose individuals targeted for collection were those that had a morphology that could easily be separated from the rocky substrate, often disc-shaped with distinct white growing edges. Geniculate individuals were collected to include the basal holdfast. The individuals were cleaned by removing epiphytic algae and invertebrates with tweezers, and then placed in a 100mg L-1 concentration of the membrane-permeable live-cell labeling fluorescent dye Calcein for 6h. This dye is absorbed by metabolically active meristematic tissue of the alga at the time of the stain, thus providing a growth benchmark for subsequently added tissue. After staining, each coralline individual (Crusticorallina spp.: a 'disc' with at least a 50% intact growing edge; B. orbigniana: a 'floret' containing 4-10 apical fronds) was attached to a small PVC stand by using z-spar epoxy putty to affix the older, non-meristematic tissue. Individuals on stands were then outplanted into the field on plates (2 crustose and 2 geniculate indiv. plate-1) and bolted onto rocky reef substrate at 10m depth MLLW at the edge of a giant kelp forest at Harris Is (57.032N, 135.277W). Coralline algae were retrieved after 2-3mo, for total outplant durations of 67d (Winter 2018), 66d (Summer 2018), and 103d (Winter 2019).

To measure linear growth, the coralline algae were imaged using a fluorescent lamp channel on a Ziess AxioZoom microscope at the UCSC Microscopy Center. Average growth extension from the original fluorescent stain was calculated for each individual using ImageJ (NIH v1.8.0) by analyzing measurements from up to 13 randomly selected points along the growing edge of the disc (Crusticorallina spp.) or from up to 17 randomly selected apical fronds in the floret (B. orbigniana).

Problem report:

Dataset only includes coralline algae individuals that were 1) not lost in the field, and 2) had sufficient stain uptake to enable measurements of new growth. Crustose coralline individuals that exhibited downward growth (versus primarily lateral growth along the growing edge of the disc) were more difficult to measure for accurate length extension. The parameter name "downward_growth" was used to indicate instances in which this occurred, and these individuals were not included in published analyses.

Data Processing Description

Processing notes from researcher:

Length measurements made using ImageJ software on appropriately scaled images taken with a Ziess AxioZoom microscope.

BCO-DMO processing notes:

Numerical fields rounded to maximum level of precision

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Data Files

File
fieldgrowth_data-1.csv (Comma Separated Values (.csv), 9.63 KB) MD5:7945dd3f5fbd64dd2ccb67521e822755 Primary data file for dataset ID 857147

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Related Publications

Bell, L., Gómez, J., Donham, E., Steller, D., Gabrielson, P., & Kroeker, K. (2022). High-latitude calcified coralline algae exhibit seasonal vulnerability to acidification despite physical proximity to a non-calcified alga. Climate Change Ecology, 3, 100049. https://doi.org/10.1016/j.ecochg.2022.100049

Parameters

Parameter	Description	Units
year	year of field deployment; format: YYYY	unitless
season	season of field deployment (summer vs winter)	unitless
species	name of species studied	unitless
alg_ID	numerical ID of individual	unitless
len_um_1	length measurement from stain to growing edge	um
len_um_2	length measurement from stain to growing edge	um
len_um_3	length measurement from stain to growing edge	um
len_um_4	length measurement from stain to growing edge	um
len_um_5	length measurement from stain to growing edge	um
len_um_6	length measurement from stain to growing edge	um
len_um_7	length measurement from stain to growing edge	um
len_um_8	length measurement from stain to growing edge	um
len_um_9	length measurement from stain to growing edge	um
len_um_10	length measurement from stain to growing edge	um
len_um_11	length measurement from stain to growing edge	um
len_um_12	length measurement from stain to growing edge	um

len_um_13	length measurement from stain to growing edge	um
len_um_14	length measurement from stain to growing edge	um
len_um_15	length measurement from stain to growing edge	um
len_um_16	length measurement from stain to growing edge	um
len_um_17	length measurement from stain to growing edge	um
downward_growth	indication of downward growth (Y = yes; N = no)	unitless

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Instruments

Dataset-specific Instrument Name	Ziess AxioZoom microscope
Generic Instrument Name	Fluorescence Microscope
Dataset-specific Description	To measure linear growth, the coralline algae were imaged using a fluorescent lamp channel on a Ziess AxioZoom microscope at the UCSC Microscopy Center.
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of fluorescence and phosphorescence instead of, or in addition to, reflection and absorption of visible light. Includes conventional and inverted instruments.

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Project Information

CAREER: Energy fluxes and community stability in a dynamic, high-latitude kelp ecosystem (High latitude kelp dynamics)

Coverage: SE Alaskan coastal waters

NSF Award Abstract:
High latitude kelp forests support a wealth of ecologically and economically important species, buffer coastlines from high-energy storms, and play a critical role in the marine carbon cycle by sequestering and storing large amounts of carbon. Understanding how energy fluxes and consumer-resource interactions vary in these kelp communities is critical for defining robust management strategies that help maintain these valuable ecosystem services. In this integrated research and education program, the project team will investigate how consumer populations respond to variability in temperature, carbonate chemistry and resource quality to influence the food webs and ecosystem stability of kelp forests. A comprehensive suite of studies conducted at the

northern range limit for giant kelp (Macrocystis pyrifera) in SE Alaska will examine how kelp communities respond to variable environmental conditions arising from seasonal variability and changing ocean temperature and acidification conditions. As part of this project, undergraduate and high school students will receive comprehensive training through (1) an immersive field-based class in Sitka Sound, Alaska, (2) intensive, mentored research internships, and (3) experiential training in science communication and public outreach that will include a variety of opportunities to disseminate research findings through podcasts, public lectures and radio broadcasts.

Consumer-resource interactions structure food webs and govern ecosystem stability, yet our understanding of how these important interactions may change under future climatic conditions is hampered by the complexity of direct and indirect effects of multiple stressors within and between trophic levels. For example, environmentally mediated changes in nutritional quality and chemical deterrence of primary producers have the potential to alter herbivory rates and energy fluxes between primary producers and consumers, with implications for ecosystem stability. Moreover, the effects of global change on primary producers are likely to depend on other limiting resources, such as light and nutrients, which vary seasonally in dynamic, temperate and high latitude ecosystems. In marine ecosystems at high latitude, climate models predict that ocean acidification will be most pronounced during the winter months, when primary production is limited by light. This project is built around the hypothesis that there could be a mismatch in the energetic demands of primary consumers caused by warming and ocean acidification and resource availability and quality during winter months, with cascading effects on trophic structure and ecosystem stability in the future. Through complementary lab and field experiments, the project team will determine 1) how temperature and carbonate chemistry combine to affect primary consumer bioenergetics across a diversity of species and 2) the indirect effects of ocean acidification and warming on primary consumers via environmentally mediated changes in the availability, nutritional quality and palatability of primary producers across seasons. Using the data from the laboratory and field experiments, the project team will 3) construct a model of the emergent effects of warming and ocean acidification on trophic structure and ecosystem stability in seasonally dynamic, high latitude environments.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1752600

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