Wet and buoyant weight measurements of macroalgae at the Sitka Sound Science Center (SSSC) from August to September 2017 (High latitude kelp dynamics project)

Website: https://www.bco-dmo.org/dataset/856663
Data Type: Other Field Results
Version: 1
Version Date: 2021-07-27

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

Contributors	Affiliation	Role
Kroeker, Kristy J.	University of California-Santa Cruz (UC Santa Cruz)	Principal Investigator
Bell, Lauren E.	University of California-Santa Cruz (UC Santa Cruz)	Contact
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This data represents weight and buoyant weight measurements of macroalgae taken at the beginning and end of a laboratory experiment that tested the effects of pH, light availability and biotic interaction on coralline algae calcification and productivity. This experiment took place at the Sitka Sound Science Center (SSSC) in Sitka, Alaska with algal samples collected between August 5, 2017 and September 21, 2017.

Table of Contents

Coverage

Spatial Extent: **Lat**:57.0498 **Lon**:-135.3235
Temporal Extent: 2017-08-07 - 2017-09-21

Dataset Description

Wet weight and buoyant weight measurements of macroalgae taken at the beginning and end of a laboratory experiment testing the effects of pH, light availability and biotic interaction on coralline algae calcification and productivity.

Acquisition Description

Methodology:

Sampling and analytical procedures:

To test the response of the coralline algae Crusticorallina spp. and Bossiella orbigniana to future OA scenarios, we used an 18-aquaria indoor experimental system with flow-through seawater at the Sitka Sound Science Center to simulate three static pHT levels (current summer = 8.0, future summer/current winter = 7.7, future winter = 7.4) under two seasonal light regimes simulated with full-spectrum aquarium lights (AI Prime HD) (summer = PPFD 55µmol m-2 s-1, 13h d-1, winter = PPFD 40µmol m-2 s-1, 6h d-1). We had a total of 3 aquaria for each of the 6 treatment combinations. A full description of the pH control for this system can be found in Kroeker et al. 2021, but in short: pH was regulated using a relay system that controlled mixing of pre-equilibrated low-pH seawater (formed by bubbling pure CO_2 gas into seawater: pH6.0) and ambient pH seawater into 9 header buckets (n=3 headers per pH treatment) that then flowed into the experimental aquaria. Each header bucket was equipped with a pH sensor (DuraFET, Honeywell) communicating with a controller (UDA 2152, Honeywell) to regulate flow of the low pH water through solenoid valves to maintain pre-programmed pH setpoints. Experimental pH levels were chosen to reflect current seasonal minimums of coastal pH measured at Harris Is. (57.032N, 135.277W) from 2016-2017, as well as end-of-century projections for Gulf of Alaska pH levels based on RCP 8.5 (-0.3 pHT from current levels). Experimental light regimes were defined using seasonal averages for day length and measured irradiance level at 10m depth at Harris Is.

Within each pH level and light treatment combination, half of the individual Crusticorallina spp. and B. orbigniana were randomly assigned to be paired in close proximity with the fleshy red alga Cryptopleura ruprechtiana (n=6 species treatment-1). All algal individuals were collected on Aug 5, 2017 at Harris Is. Total experimental duration was 45d (Aug 7-Sept 21, 2017).

The effects of each experimental pH and light treatment combination and fleshy red algal association on coralline net calcification rate were assessed using the buoyant weight technique (Jokiel et al. 1978), as well as the alkalinity anomaly technique. To determine total relative change in calcified mass over the experimental period, each coralline algae's buoyant weight was measured to the nearest 0.0001g at the beginning and end of the experiment on a balanced platform suspended below a microbalance in a temperature-monitored seawater bath. To ensure precision, buoyant weights were repeated for each individual until measurements differed by less than ±0.005g, and then an average was taken of the measurements falling in this range of precision. Initial and final buoyant weights (BW; g) were used to calculate relative net calcification rate (RCRnet; g g-1 d-1) of each individual alga using the equation: RCRnet = (log(BWfinal/BWinitial)*100)/Δt where Δt (d) is the total days elapsed between the beginning and end of the experiment.

Growth rates of *C. ruprechtiana* reared in association with coralline algae in the different treatment conditions were quantified by measuring tissue wet weights (WW; g) at the beginning and end of the experiment. Thalli were removed from seawater, patted uniformly dry, and immediately weighed on a standard microbalance to the nearest 0.0001g. Relative growth rate (RGRnet; g g-1 d-1) of each individual alga was calculated using the equation: RGRnet = (log(WWfinal/WWinitial)*100)/Δt

where Δt (d) is the total days elapsed between the beginning and end of the experiment.

Problem report:

When processing these data for analysis and publication, we filtered out any individual with a weighing flag (weighing_flag = "y"), and any individuals in Poor condition at the end of the experiment (quality_code = "P")

Processing Description

Processing notes from researcher:

When processing these data for analysis and publication, we filtered out any individual with a weighing flag (weighing_flag = "y"), and any individuals in Poor condition at the end of the experiment (quality_code = "P")

BCO-DMO processing notes:

- Renamed fields "tank.rep", "alg.ID", and "assoc." to meet BCO-DMO naming conventions

- Converted date to YYYY-MM-DD format

- Rounded numerical fields

[table of contents | back to top]

Related Publications

Jokiel, P.L., Maragos, J.E., & Franzisket, L. (1978). Coral growth: buoyant weight technique. Coral Reefs: Research Methods.
Methods

Kroeker, K. J., Powell, C., & Donham, E. M. (2020). Windows of vulnerability: Seasonal mismatches in exposure and resource identity determine ocean acidification’s effect on a primary consumer at high latitude. Global Change Biology, 27(5), 1042–1051. doi:10.1111/gcb.15449
Related Research

LE Bell, JB Gómez, E Donham, DL Steller, PW Gabrielson, KJ Kroeker (in review) High-latitude calcified coralline algae exhibit seasonal vulnerability to acidification despite physical proximity to a non-calcified alga. Manuscript submitted Jun 1, 2021.
Results
Results

[table of contents | back to top]

Parameters

Parameter	Description	Units
species	taxonomic identifier of individual considered	unitless
header	numerical ID of experimental tank replicate	unitless
tank_replicate	alphabetic ID of experimental tank replicate	unitless
alg_ID	alphabetic ID of indiv., unique to header/tank.rep	unitless
pH	experimental pH treatment level	unitless
light	experimental light regime treatment (winter or summer)	unitless
association_treatment	experimental algal association treatment (w = paired with C. ruprechtiana; wo = no pairing)	unitless
date_initial	date (AKST) of pre-experiment mass measurements; format: YYYY-MM-DD	unitless
ww_initial	initial wet weight of experimental individual	grams (g)
bwavg_initial	initial mean buoyant weight of experimental individual	grams (g)
date_final	date (AKST) of post-experiment mass measurements; format: YYYY-MM-DD	unitless
ww_final	final weight of experimental individual	grams (g)
bwavg_final	final mean buoyant weight of experimental individual	grams (g)
quality_code	indicator of algal condition at exp. End (R = robust; F = fair; P = poor)	unitless
weighing_flag	indicator of issue during mass measurements (n = no issue; y = issue)	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Honeywell DuraFET pH sensor
Generic Instrument Name	pH Sensor
Dataset-specific Description	Each header bucket was equipped with a pH sensor (DuraFET, Honeywell) communicating with a controller (UDA 2152, Honeywell) to regulate flow of the low pH water through solenoid valves to maintain pre-programmed pH setpoints.
Generic Instrument Description	General term for an instrument that measures the pH or how acidic or basic a solution is.

Dataset-specific Instrument Name	18-aquaria indoor experimental system
Generic Instrument Name	Aquarium
Dataset-specific Description	To test the response of the coralline algae Crusticorallina spp. and Bossiella orbigniana to future OA scenarios, we used an 18-aquaria indoor experimental system with flow-through seawater at the Sitka Sound Science Center to simulate three static pHT levels (current summer = 8.0, future summer/current winter = 7.7, future winter = 7.4) under two seasonal light regimes simulated with full-spectrum aquarium lights (AI Prime HD) (summer = PPFD 55μmol m-2 s-1, 13h d-1, winter = PPFD 40μmol m-2 s-1, 6h d-1). We had a total of 3 aquaria for each of the 6 treatment combinations.
Generic Instrument Description	Aquarium - a vivarium consisting of at least one transparent side in which water-dwelling plants or animals are kept

Dataset-specific Instrument Name	Sartorius Entris 224-1S Microbalance
Generic Instrument Name	Scale
Dataset-specific Description	Growth rates of C. ruprechtiana reared in association with coralline algae in the different treatment conditions were quantified by measuring tissue wet weights (WW; g) at the beginning and end of the experiment. Thalli were removed from seawater, patted uniformly dry, and immediately weighed on a standard microbalance to the nearest 0.0001g.
Generic Instrument Description	An instrument used to measure weight or mass.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]