Macroalgal production rates calculated from field data collected during macroalgal surveys in Sitka Sound, Alaska kelp beds from 2017 to 2019

Website: https://www.bco-dmo.org/dataset/882071
Data Type: Other Field Results
Version: 1
Version Date: 2022-10-10

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 (UCSC)	Principal Investigator
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Abstract
Macroalgal production rates calculated from field data collected during macroalgal surveys in Sitka Sound, Alaska kelp beds from 2017 to 2019. These data will be published in Bell, L. E. and Kroeker, K. J. (in review).

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Coverage

Spatial Extent: **N**:57.03896 **E**:-135.27754 **S**:56.9875 **W**:-135.35718
Temporal Extent: 2017-01-09 - 2019-08-01

Methods & Sampling

See the Supplemental File "Methods_productionrates.pdf" which includes equations in-line with methods text.

Additional Funding Details:
In addition to primary funding from the NSF award OCE-1752600 additional funding was provided from The David and Lucile Packard Foundation and the North Pacific Research Board's Graduate Student Research Award (1748-01) to Lauren Bell, PhD University of California Santa Cruz, Award title: "Fish Habitat, Fishes and Invertebrates, Lower Trophic Level Productivity Effect of substrate on herring roe response to global change."

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* File "Sitkakelps_calculated_production.rates.csv" imported into the BCO-DMO data system.

* Dates changed to ISO format
* Species list with codes and scientific names extracted from parameter information. Matched to known taxon ids using WoRMS taxa match (2022-09-06). The spelling of "Laminaria setchelii" changed to "Laminaria setchellii" with two Ls after confirming the change with the data submitter. Species list along with identifiers attached as a supplemental data table.
* Latitude and Longitude added to main data table from the provided site list.
* The following columns were rounded to four decimal places after submitter indicated that was the appropriate precision. (p g SE_g n SE_nP_dry SE_P_dry P_carbon SE_P_carbon P_nitrogen SE_P_nitrogen)

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Data Files

File
kelp-production-rates.csv (Comma Separated Values (.csv), 11.84 KB) MD5:6ddf21e3903953dede76ca4fd03087be Primary data file for dataset ID 882071

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Supplemental Files

File
Methods for macroalgal production rates filename: Methods_productionrates.pdf (Portable Document Format (.pdf), 111.96 KB) MD5:b24ba6e0c5f32c9939de743f853d2377 Methods for macroalgal production rates including equations in-line with methods text.
Sitka macroalgal survey site list filename: site_list.csv (Comma Separated Values (.csv), 259 bytes) MD5:785b37ebc9f99bea71257234529ad278 Site list for macroalgal surveys conducted in Sitka, Alaska between 2017 to 2020. Parameters (column name, description, units): Site, Site name,unitless Latitude, latitude of site, decimal degrees Longitude,longitude of site, decimal degrees
Sitka macroalgal survey species list filename: species_list.csv (Comma Separated Values (.csv), 490 bytes) MD5:983f490f673acb204083528f4f11e380 Species list for macroalgal surveys conducted in Sitka, Alaska between 2017 to 2020. Parameters (column name, description, units): Sp, species code used in related datasets (e.g. MPYR),unitless ScientificName,The accepted scientific name for the species (as of 2022-09),unitless AphiaID,Taxonomic identifier AphiaID for the species (see World Register of Marine Species),unitless LSID,Life Sciences Identifier (LSID) for the species,unitless

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Related Publications

Bell, L. E., & Kroeker, K. J. (2022). Standing Crop, Turnover, and Production Dynamics of Macrocystis pyrifera and Understory Species Hedophyllum nigripes and Neoagarum fimbriatum in High Latitude Giant Kelp Forests. Journal of Phycology, 58(6), 773–788. Portico. https://doi.org/10.1111/jpy.13291
Results

Gevaert, F., Davoult, D., Creach, A., Kling, R., Janquin, M.-A., Seuront, L., & Lemoine, Y. (2001). Carbon and nitrogen content of Laminaria saccharina in the eastern English Channel: biometrics and seasonal variations. Journal of the Marine Biological Association of the United Kingdom, 81(5), 727–734. https://doi.org/10.1017/s0025315401004532 https://doi.org/10.1017/S0025315401004532
Methods

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
Software

Rassweiler, A., Arkema, K. K., Reed, D. C., Zimmerman, R. C., & Brzezinski, M. A. (2008). NET PRIMARY PRODUCTION, GROWTH, AND STANDING CROP OFMACROCYSTIS PYRIFERAIN SOUTHERN CALIFORNIA. Ecology, 89(7), 2068–2068. https://doi.org/10.1890/07-1109.1
Methods

Rassweiler, A., Reed, D. C., Harrer, S. L., & Nelson, J. C. (2018). Improved estimates of net primary production, growth, and standing crop of Macrocystis pyrifera in Southern California. Ecology, 99(9), 2132–2132. Portico. https://doi.org/10.1002/ecy.2440
Methods

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Parameters

Parameter	Description	Units
Site	Name of rocky reef location in Sitka Sound where survey occurred. See methods for lat/long	unitless
Latitude	Latitude of site	decimal degrees
Longitude	Longitude of site	decimal degrees
Sp	Species of macroalga surveyed (MPYR = Macrocystis pyrifera, NFIM = Neoagarum fimbriatum, HNIG = Hedophyllum nigripes)	unitless
surveyperiod_start	Date of survey period start. Format is ISO 8601 date format YYYY-MM-DD.	unitless
surveyperiod_end	Date of survey period end. Format is ISO 8601 date format YYYY-MM-DD.	unitless
p	Per capita plant loss rate	per day (d-1)
g	Site-averaged specific growth rate	per day (d-1)
SE_g	Standard error for site-averaged specific growth rate. Error calculated from replicate plants	per day (d-1)
n	Net rate of change	per day (d-1)
SE_n	Standard error for net rate of change. Error calculated from replicate plants.	per day (d-1)
prctC	Average carbon content of macroalgal tissue	percent (%)
SE_prctC	Standard error for average carbon content of macroalgal tissue. Error calculated from replicate tissue samples	percent (%)
prctN	Average nitrogen content of macroalgal tissue	percent (%)
SE_prctN	Standard error for average nitrogen content of macroalgal tissue. Error calculated from replicate tissue samples	percent (%)
P_dry	Production of dry mass per square meter per day	grams per meter squared per day (g/m-2/d-1)
SE_P_dry	Standard error in production of dry mass, calculated with Monte Carlo methods (see methods)	grams per meter squared per day (g/m-2/d-1)
P_carbon	Production of carbon mass per square meter per day	grams per meter squared per day (g/m-2/d-1)
SE_P_carbon	Standard error in production of carbon mass, calculated with Monte Carlo methods (see methods)	grams per meter squared per day (g/m-2/d-1)
P_nitrogen	Production of nitrogen mass per square meter per day	grams per meter squared per day (g/m-2/d-1)
SE_P_nitrogen	Standard error in production of nitrogen mass, calculated with Monte Carlo methods (see methods)	grams per meter squared per day (g/m-2/d-1)

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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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