Algal consumption data from Tegula in the presence of the predator Pisaster ochraceus, displaying anti-predatory responses or not within mesocosms at Bodega Marine Lab in 2018.

Website: https://www.bco-dmo.org/dataset/947757
Data Type: experimental
Version: 1
Version Date: 2025-01-02

Project
» Trophic consequences of ocean acidification: Intertidal sea star predators and their grazer prey (BOAR Trophic)

Contributors	Affiliation	Role
Gaylord, Brian	University of California - Davis: Bodega Marine Laboratory (UC Davis-BML)	Principal Investigator
Ng, Gabriel	University of California - Davis: Bodega Marine Laboratory (UC Davis-BML)	Student
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
To examine the impacts of fear removal on the strength of trophic cascades, we measured the amount of algae (Ulva spp.) consumed by Tegula funebralis that either displayed either an anti-predatory response to its predators, Pisaster ochraceus and Cancer productus, or ignored the predators. Additionally, we used two species of predators with differing consumption rates to test how predator traits might mediate the effect of removal on trophic cascade strength. The experiment was conducted within laboratory mesocosms at Bodega Marine Lab in 2018. This dataset reports results for experiments with Cancer productus as the predator. See "Related Datasets" section for results from the experiments with Pisaster ochraceus as the predator.

Table of Contents

Coverage

Location: Bodega Marine Laboratory, Bodega Bay, CA
Spatial Extent: **N**:38.372172 **E**:-123.048703 **S**:38.309334 **W**:-123.076438
Temporal Extent: 2018-05-23 - 2018-06-04

Methods & Sampling

To examine the impacts of fear removal on the strength of trophic cascades, we measured the amount of algae (*Ulva spp.*) consumed by *Tegula funebralis* that displayed either an anti-predatory response to its predators, *Pisaster ochraceus* and *Cancer productus,* or ignored the predators. Additionally, we used two species of predators with differing consumption rates to test how predator traits might mediate the effect of removal on trophic cascade strength. The experiment was conducted within laboratory mesocosms at Bodega

Marine Lab in 2018.

Pisaster ochraceus, *Cancer productus*, and *Tegula funebralis* were collected along the coastline of Sonoma County, California in 2018. Both *Pisaster* and *Tegula* were sampled at Carmet Beach (38.372172 N, -123.076438 W), and the *Cancer* crabs were gathered subtidally from Doran Beach (38.309334 N, -123.048703 W).

When conducting the fear and no-fear treatments for *Tegula,* we had 20 mesocosms with ten *Tegula* each when paired with *Pisaster* as the predator. Ten of the mesocosms were used for the fear treatment where we introduced *Pisaster* cues from a secondary container to provoke a behavioral fear response in *Tegula*. The other ten mesocosms contained no *Pisaster* cues and represented the no-fear treatment. In the fear treatment, we culled *Tegula* at the baseline rate of 8% per day, and we culled *Tegula* at the enhanced rate of 33% per day in the no-fear treatment. *Ulva* sp. was used as the basal resource with *Tegula,* and we measured the change in *Ulva* weight over the duration of the experiment. We dried the *Ulva* for two hours before weighing them. We also had ten mesocosms with just seawater and *Ulva* as a control to measure the natural degradation of *Ulva* over the course of the experiment.

We conducted similar fear and no-fear treatments with *Tegula* except paired with *Cancer* as the predator. The contrast in the effect of fear on the trophic cascades between the two predators shows how predators of differing dangerousness can influence the role of fear in trophic cascades. Like the *Pisaster-Tegula* experiments, we used 20 mesocosms with ten *Tegula* each for the *Cancer-Tegula* experiments. We used ten of those mesocosms for the fear treatment where *Cancer* cues are introduced to provoke a behavioral fear response and used the remaining ten mesocosms for the no-fear treatment. In the fear treatment, *Tegula* were culled at the baseline rate of 34% per day, and in the no-fear treatment, *Tegula* were culled at the enhanced rate of 57% per day, simulating *Cancer* predation rates.

To analyze the role of fear and predator identity on amount of algae consumed by *Tegula*, we ran a generalized linear model with a gamma distribution to account for the heteroscedasticity in the amount of algae consumed. Predator identity and the presence of fear were used as fixed effects. We followed up each generalized linear mixed effects model with explicit *a priori* planned contrasts with either a Bonferroni or Tukey correction. For *Tegula,* we compared whether afraid snails consumed significantly different amounts of algae for each predator and whether that difference was different between predators.

Organism identifiers:

Scientific Name, Life Science Identifier (LSID)
Pisaster ochraceus,urn:lsid:marinespecies.org:taxname:240755
Cancer productus,urn:lsid:marinespecies.org:taxname:440382
Ulva spp.,urn:lsid:marinespecies.org:taxname:144296
Tegula funebralis, urn:lsid:marinespecies.org:taxname:534190

BCO-DMO Processing Description

* The originally provided "Pisaster tegula phase 3 stats.csv" with no modifications was packaged along with related dataset (947753) files and R-scripts into Algal_consumption_analysis_package.zip and attached as a supplemental file.

* Table from submitted file "Pisaster tegula phase 3 stats.csv" was imported into the BCO-DMO data system for this dataset.
** In the BCO-DMO data system missing data identifiers are displayed according to the format of data you access. For example, in csv files it will be blank (null) values. In Matlab .mat files it will be NaN values. When viewing data online at BCO-DMO, the missing value will be shown as blank (null) values.

* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]

* Date converted to ISO 8601 format

* ISO DateTime with timezone (UTC) column added in ISO 8601 format.

* Taxonomic identifiers added to the metadata (Life Science Identifiers (LSID)). Names matched using the World Register of Marine Species (WoRMS) on 2024-01-02.

* Bounding box for dataset determined by sampling locations provided and location of experiment at Bodega Bay Marine Laboratory (38.3180548,-123.0743098).

[table of contents | back to top]

Related Datasets

IsRelatedTo

Ng, G., Gaylord, B. (2025) **Algal consumption data from Tegula in the presence of the predator Pisaster ochraceus, displaying anti-predatory responses or not within mesocosms at Bodega Marine Lab in 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-02 http://lod.bco-dmo.org/id/dataset/947757 [view at BCO-DMO]
Relationship Description: Data from the same study. These data are results from different predator species in the experiment.

[table of contents | back to top]

Parameters

Parameter	Description	Units
date	Date of data collection. Reported in local time zone US Pacific (PST/PDT).	unitless
time	Time of data collection. Reported in local time zone US Pacific (PST/PDT).	unitless
ISO_DateTime_UTC	Datetime with timezone of data collection (ISO 8601 format, time zone UTC as "Z")	unitless
pisaster	Whether predatory Pisaster cue were used in the treatment or not.	unitless
pisaster_size	Size of the Pisaster used (length in mm from madreporite to longest arm) if applicable	unitless
container	Unique identifier for the mesocosm used in the experiment	unitless
seatable	Indicates which of two seatables were used in the experiment.	unitless
Treatment	Indicates whether the data collected are from the treatment trials or control trials	unitless
snail	Indicate number of snails remaining in the mesocosms as they were removed	unitless
start	Indicates the starting algal weight	grams (g)
end	Indicates the final algal weight in grams if Tegula had mostly consumed the piece of algae, which were then replaced with a new starting algal weight	grams (g)
algae_consumed	The difference between starting and ending weight for a given piece of algae	grams (g)
Day	Number of day since the start of the experiment	count (days)

[table of contents | back to top]

Project Information

Trophic consequences of ocean acidification: Intertidal sea star predators and their grazer prey (BOAR Trophic)

Coverage: Central California coast, USA

NSF Award Abstract:
The absorption of human-produced carbon dioxide into the world's oceans is altering the chemistry of seawater, including decreasing its pH. Such changes, collectively called "ocean acidification", are expected to

influence numerous types of sea creatures. This project examines how shifts in ocean pH affect animal behavior and thus interactions among species. It uses a case study system that involves sea star predators, snail grazers that they eat, and seaweeds consumed by the latter. The rocky-shore habitats where these organisms live have a long history of attention, and new findings from this work will further extend an already-large body of marine ecological knowledge. The project provides support for graduate and undergraduate students, including underrepresented students from a nearby community college. The project underpins the development of a new educational module for local K-12 schools. Findings will moreover be communicated to the public through the use of short film documentaries, as well as through established relationships with policy, management, and industry groups, and contacts with the media.

Ocean acidification is a global-scale perturbation. Most research on the topic, however, has examined effects on single species operating in isolation, leaving interactions among species underexplored. This project confronts this knowledge gap by considering how ocean acidification may shift predator-prey relationships through altered behavior. It targets as a model system sea stars, their gastropod grazer prey, and macoalgae consumed by the latter, via four lines of inquiry. 1) The project examines the functional response of the focal taxa to altered seawater chemistry, using experiments that target up to 16 discrete levels of pH. This experimental design is essential for identifying nonlinearities and tipping points. 2) The project addresses both consumptive and non-consumptive components of direct and indirect species interactions. The capacity of ocean acidification to influence such links is poorly known, and better understanding of this issue is a recognized priority. 3) The project combines controlled laboratory experiments with field trials that exploit tide pools and their unique pH signatures as natural mesocosms. Field tests of ocean acidification effects are relatively rare and are sorely needed. 4) A final research phase expands upon the above three components to address effects of ocean acidification on multiple additional taxa that interact in rocky intertidal systems, to provide a broad database that may have utility for future experiments or modeling.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1636191

[table of contents | back to top]