Predation data of tethered Tegula funebralis in the presence of predator Cancer productus within laboratory mesocosms at Bodega Marine Lab in 2018

Website: https://www.bco-dmo.org/dataset/959435
Data Type: experimental
Version: 1
Version Date: 2025-04-21

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

Contributors	Affiliation	Role
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Abstract
To examine the impacts of fear removal on the strength of trophic cascades, we measured predation rates on tethered and untethered Tegula funebralis in the presence of Pisaster ochraceus and Cancer productus. Data from these experiments were used to estimate predation rates on Tegula that did not display a behavioral fear response. Additionally, we used two predator species of differing attack rates to examine how predator identity might influence the loss of fear in a trophic cascade. The experiment was conducted within laboratory mesocosms at Bodega Marine Lab in 2018. This dataset reports the results for experiments with Cancer productus as the predator. See related dataset https://www.bco-dmo.org/node/959441 for results with predator Pisaster ochraceus.

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Coverage

Location: Collections along coastline of Sonoma County, CA; mesocosms at Bodega Marine Lab, CA
Spatial Extent: **N**:38.372172 **E**:-123.076438 **S**:38.309334 **W**:-123.076438
Temporal Extent: 2018-08-28 - 2018-09-05

Dataset Description

See "Related Datasets" section for other datasets to be published in Ng & Gaylord (2025, in-prep). These datasets are also listed on the "Related-Resource" page for that results publication https://www.bco-

dmo.org/related-resource/948176

All datasets in this project can be viewed from the "Dataset Collections" of the project page https://www.bco-dmo.org/project/712799

Of particular note are:

Dataset: Fear behavior with predators: tethered Tegula funebralis in the presence of predator Pisaster ochraceus
https://www.bco-dmo.org/dataset/959441
(same tethered organism, different predator)

Dataset: Fear behavior with predators: tethered Nucella lamellosa in the presence of predator Pisaster ochraceus
https://www.bco-dmo.org/node/948222
(different tethered organism, different predator)

Methods & Sampling

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).

We introduced predators to snails that either displayed a fear response or did not to determine the baseline and enhanced culling rates in the fear and no-fear treatments respectively. For the enhanced culling rates where prey did not have a behavioral fear response, (i.e. did not leave the water in the presence of predators), we tethered a subset of our snails when subjecting them to predators. These latter trials provided data on predation rates when snails spent 100% of their time underwater such that they could not implement their standard fear-induced flight responses. We tethered snails using 10mm long mono-filament line attached to the shell with cyanoacrylate adhesive and to the base of the mesocosm using epoxy. Snails were distributed uniformly over the mesocosm. For *Tegula,* we used 20 mesocosms each with ten *Tegula* and an individual *Pisaster* (86.7mm +/- 14.4mm from madreporite to tip of longest arm). Ten of the mesocosms contained tethered snails and the other half had untethered snails. We used a similar approach with 20 *Cancer* crabs (136.8mm +/- 10.8mm carapace width).

We ran a linear regression on logged proportion of snails surviving with tethering, duration of the experiment, and their interactive effects as fixed factors.

Organism identifiers (taxonomic names used in dataset metadata):

Scientific Name, Life Science Identifier (LSID)
Tegula funebralis, urn:lsid:marinespecies.org:taxname:534190
Nucella lamellosa, urn:lsid:marinespecies.org:taxname:404218
Pisaster ochraceus,urn:lsid:marinespecies.org:taxname:240755
Cancer productus,urn:lsid:marinespecies.org:taxname:440382

Data Processing Description

See "Supplemental Files" for analysis package (R-language).

BCO-DMO Processing Description

* Raw data and analysis R-scripts for three related datasets were packaged into the supplemental file Tegula_tethering_with_predators_analysis_package.zip (no modifications to files). The zip file was attached to two datasets (BCO-DMO datasets 959435 and 959441).

* Data table from submitted file "Cancer tegula teth stats.csv" was imported into the BCO-DMO data system. Table will appear on this dataset page as Data File:
959435_v1_predation_t-funebralis-cancer.csv (with other download format options).

* Column "Date" renamed to "Date_local", and "Time" renamed to "Time_local". [US/Pacific local time]

* New column "ISO_DateTime_UTC" added by combining "Date_local" and "Time_local" with timezone conversion to UTC in ISO 8601 format.

* Any column names with characters other than letters, numbers and underscores were renamed to meet 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]

Missing Data Identifiers:
* 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.

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

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Data Files

File
959435_v1_predation_t-funebralis-cancer.csv (Comma Separated Values (.csv), 25.30 KB) MD5:7777914e33540f6b89c9cec096548c34 Primary data file for dataset ID 959435, version 1

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Supplemental Files

File
Tegula tethering with predators analysis package (R-language) filename: Tegula_tethering_with_predators_analysis_package.zip (ZIP Archive (ZIP), 53.09 KB) MD5:c9764a6183bcbe31276683ee3eaa176d This analysis and plotting package contains scripts for analyzing the laboratory data. Note that the csv data tables included in this package are the exact format of the data required to import into the supplied R-scripts. They differ slightly form the data provided from the BCO-DMO data system due to column naming requirements and date formats (see "BCO-DMO Processing" section). Zip file contents: "Cancer tegula teth stats.csv" = Tegula tethering data with Cancer crabs. Data with the filename and column names required for the analysis R-script. This is the source file imported into the BCO-DMO data system for dataset 959435 version 1 (https://www.bco-dmo.org/dataset/959435). "Cancer tegula predation stats final.R" = Tegula predation analysis with Cancer productus "Pisaster pred data.csv" = Tegula tethering data with Pisaster seastar. Data with the filename and column names required for the analysis R-script. This is the source file imported into the BCO-DMO data system for dataset 959441 version 1 (https://www.bco-dmo.org/dataset/959441). "Pisaster behavior stats final.R" = Tegula predation analysis with Pisaster ochraceus.

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Related Publications

Ng, G., & Gaylord, B. (2025). Identifying the role of fear in trophic cascades. Ecosphere. Manuscript in preparation.
Results

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Related Datasets

IsRelatedTo

Ng, G., Gaylord, B. (2025) **Algal consumption data from Tegula in the presence of the predator Cancer productus, 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 doi:10.26008/1912/bco-dmo.947753.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

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 doi:10.26008/1912/bco-dmo.947757.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Barnacle consumption of Nucella lamellosa that either displayed behavioral or morphological fear responses or not in the presence of predators within laboratory mesocosms at Bodega Marine Lab in 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-09 doi:10.26008/1912/bco-dmo.948228.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Behavioral data of Nucella lamellosa in the presence of predators within laboratory mesocosms at Bodega Marine Lab in 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-09 doi:10.26008/1912/bco-dmo.948204.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Behavioral data of Tegula funebralis in the presence of predator Cancer productus within laboratory mesocosms at Bodega Marine Lab in 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-09 doi:10.26008/1912/bco-dmo.948210.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Behavioral data of Tegula funebralis in the presence of predator Pisaster ochraceus within laboratory mesocosms at Bodega Marine Lab in 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-09 doi:10.26008/1912/bco-dmo.948216.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Nucella lamellosa morphometric measurements after induction in the presence of predatory Pisaster ochraceus at Bodega Marine Laboratory in 2018 and 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-04-21 doi:10.26008/1912/bco-dmo.959533.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Predation data of tethered Nucella lamellosa in the presence of predator**

Pisaster ochraceus within laboratory mesocosms at Bodega Marine Lab in 2019. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-09 doi:10.26008/1912/bco-dmo.948222.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

Ng, G., Gaylord, B. (2025) **Predation data of tethered Tegula funebralis in the presence of predator Pisaster ochraceus within laboratory mesocosms at Bodega Marine Lab in 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-04-21 doi:10.26008/1912/bco-dmo.959441.1 [view at BCO-DMO]
Relationship Description: Data from experiments to be published in results publication Ng & Gaylord (2025, in-prep). See "Related-Resource" page for that results publication https://www.bco-dmo.org/related-resource/948176

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Parameters

Parameter	Description	Units
Date_local	date (local, US/Pacific time zone) of data collection.	unitless
Day	the number of days since the start of the experiment.	days
Time_local	time (local, US/Pacific time zone) of data collection.	unitless
ISO_DateTime_UTC	datetime with timezone (UTC, in ISO 8601 format) of the data collection.	unitless
Table	sea table identifier. Which of two sea tables were used in the experiment.	unitless
Size	the carapace width of the crab used in mm if applicable.	millimeters (mm)
Tethered	description	unitless
Sex	description	unitless
Containers	Mesocosm identifier. A unique identifier for individual mesocosm	unitless
Alive	number of Tegula still alive.	unitless
Alive_C	the number of snails that are still alive minus the number of snails that have freed themselves from the tether which may lead to negative numbers initially	unitless
Prop	the proportion of tethered snails still alive after accounting for snails that have escaped.	unitless

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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.

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Funding

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

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