

Predation data of tethered *Nucella lamellosa* in the presence of predator *Pisaster ochraceus* within laboratory mesocosms at Bodega Marine Lab in 2019

Website: <https://www.bco-dmo.org/dataset/948222>

Data Type: experimental

Version: 1

Version Date: 2025-01-09

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
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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 *Nucella lamellosa* in the presence of *Pisaster ochraceus*. Data from these experiments were used to estimate predation rates on *Nucella* that did not display behavioral fear response. Similar predation trials were conducted with morphologically induced *Nucella* to estimate the effect of morphological defenses on predation rates. The experiment was conducted within laboratory mesocosms at Bodega Marine Lab in 2019.

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Coverage

Location: Collections along coastline of Sonoma County and Washington Park, CA; mesocosms at Bodega Marine Lab, CA

Spatial Extent: N:48.50219 E:-122.691865 S:38.372172 W:-123.076438

Temporal Extent: 2019-02-19 - 2019-03-08

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 funebris* in the presence of predator *Pisaster ochraceus*

<https://www.bco-dmo.org/dataset/959441>

(different tethered organism, same predator)

Dataset: Fear behavior with predators: tethered *Tegula funebris* in the presence of predator *Cancer productus*

<https://www.bco-dmo.org/node/959435>

(same tethered organism, different predator)

Methods & Sampling

Pisaster were collected at Carmet Beach (38.372172 N, 123.076438 W). *Nucella lamellosa* were collected at Washington Park in Anacortes, Washington (48.502190 N, -122.691865 W) in July 2018.

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. We crossed our tethered treatment with the morphological induction treatment for the predation trials similar to the trials measuring the intensity of behavioral fear response. We created ten mesocosms each containing five tethered *Nucella*. Half of the mesocosms contained induced *Nucella* and the other half contained *Nucella* that had not been induced. We also created ten mesocosms with five untethered *Nucella* each; half of these latter mesocosms again contained induced *Nucella* and the other half again contained *Nucella* that had not been induced. This overall setup for *Nucella* allowed us to estimate the culling rates for when *Nucella* displayed no fear response, a behavioral fear response, a morphological fear response, or both. The mesocosms were checked twice a day for predation events, and the predation trials lasted until all of the snails had been consumed.

We ran a linear regression on logged proportion of snails surviving with tethering, duration of the experiment, and their interactive effects as fixed factors. For *Nucella*, we also added the average retraction distance of the *Nucella* within each container as another predictor, along with the three-way interaction with tethering and duration of the experiment.

Organism identifiers (taxonomic names used in dataset metadata):

Scientific Name, Life Science Identifier (LSID)

Nucella lamellosa, urn:lsid:marinespecies.org:taxname:404218

Pisaster ochraceus, urn:lsid:marinespecies.org:taxname:240755

Data Processing Description

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

BCO-DMO Processing Description

* Raw data and analysis script were bundled into file *Nucella_predation_analysis_package.zip* with no file

changes. Attached as a supplemental file.

* Data table from submitted file "Predation stats.csv" was imported into the BCO-DMO data system. Values "" and "nd" imported as missing data values. Table will appear on this dataset page as Data File: 948222_v1_predation_n-lamellosa.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
948222_v1_predation_n-lamellosa.csv (Comma Separated Values (.csv), 149.91 KB) MD5:067101d6569b5362cb9524c65f80d778
Primary data file for dataset ID 948222, version 1

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Supplemental Files

File
Nucella predation analysis package (R-language) filename: Nucella_predation_analysis_package.zip (ZIP Archive (ZIP), 151.82 KB) MD5:fedc8e5c93255c39c543b2102fd86d
Nucella predation analysis R-scripts. 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 from 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:
"Predation stats.csv" = Nucella predation data. Data with the filename and column names required for the analysis R-scripts. This is the source file imported into the BCO-DMO data system for dataset 948222 version 1 (https://www.bco-dmo.org/dataset/948222).
"Predation stats.R" = Nucella predation analysis part 1
"Predation stats round 2.R" = Nucella predation analysis part 2
Predation with retraction stats.R =Nucella predation analysis part 3

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Related Publications

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

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 funebris 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 funebris 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 Tegula funebris 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 2025-04-21 doi:10.26008/1912/bco-dmo.959435.1 [[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 funebris 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
Day	the number of days since the start of the experiment.	days
Date_local	date (local, US/Pacific time zone) of data collection.	unitless
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
Sump	Sump identifier. Which of two sump tanks were used in the experiment.	unitless
Container	mesocosm identifier. A unique identifier for individual mesocosm.	unitless
Container_past	mesocosm identifier. a unique identifier for past mesocosms the snails were housed in.	unitless
Indiv	a unique identifier for each individual Nucella (another identifier separate from to column "Individual")	unitless
Induced	whether the snail has an induced morphology or not.	unitless
Tethered	whether the snails were tethered (T) or not (NT).	unitless
Pisaster_size	the size of the Pisaster used (length in mm from madreporite to longest arm).	millimeters (mm)

Individual	a unique identifier for individual Nucella (another identifier separate from to column "Indiv")	units
Length	the length of the Nucella shell from the apex to the notch (in mm).	millimeters (mm)
Height	the vertical distance from the base of the aperture to the top of the shell (in mm).	millimeters (mm)
Retraction	the retraction distance of the snail (in mm).	millimeters (mm)
Weight	the weight of the snail (in grams).	grams (g)
Survival	whether the individual Nucella is alive or not with 1 coded as alive and 0 coded as dead.	unitless
Eating	denotes whether the individual Nucella was being consumed by Pisaster at that observation point.	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 macroalgae 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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