

# Anti-predatory and foraging behaviors of whelks from laboratory experiments at Bodega Marine Laboratory in 2017

**Website:** <https://www.bco-dmo.org/dataset/869563>

**Data Type:** experimental

**Version:** 1

**Version Date:** 2022-03-16

## 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 investigate anti-predatory and foraging behaviors of whelks, we conducted laboratory experiments at Bodega Marine Laboratory in 2017 to test whether previous predator exposure had a sustained effect on prey foraging and in turn on a basal resource, even after the predator was removed. We tested for both behavioral and morphological legacies of prior predation. The study system consisted of a tri-trophic food chain, using the red rock crab, *Cancer productus*, as the predator, the carnivorous whelk, *Nucella ostrina*, as the prey species, and the California mussel, *Mytilus californianus*, as the basal resource.

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## Coverage

**Spatial Extent:** Lat:38.33325 Lon:-123.04805

**Temporal Extent:** 2017-08-13 - 2017-08-27

## Methods & Sampling

This dataset represents laboratory experiments to test whether previous predator exposure had a sustained effect on prey foraging and in turn on a basal resource, even after the predator was removed. We tested for both behavioral and morphological legacies of prior predation. The study system consisted of a tri-trophic food chain, using the red rock crab, *Cancer productus*, as the predator, the carnivorous whelk, *Nucella ostrina*, as the prey species, and the California mussel, *Mytilus californianus*, as the basal resource.

The first step of the experiment consisted of conditioning the intermediate consumer (*Nucella ostrina*) in the tri-trophic food web to the presence of predators or not. The above conditioning period lasted 75 days, a duration that has been documented in previous studies to cause a morphological change in *Nucella*. Then we tested for proportional changes in the length and weight of our snails that may have occurred during the conditioning phase and the weight:length ratio by repeating the measurements we had made at the outset of our experiments. Using a subset of the conditioned and naïve snails (n=80 each), we next tested how predator conditioning affected their behavior and foraging when they were subsequently exposed to predator cues or not (Ng & Gaylord (2020), Fig. 2). If predator conditioning altered *Nucella* morphology and their foraging, we also wanted to examine whether a snail's size might alter its response to predator cues and its foraging on mussels. We therefore first grouped the *Nucella* into five size classes of 16 *Nucella* each, from smallest to largest, creating a size gradient. We created this array of multiple size classes for both predator-conditioned and naïve snails. We then divided each set of 16 snails into two containers (33 mm × 20 mm × 11.5 mm) with eight *Nucella* individuals per container; half of the containers received outflow from sumps containing crabs and half received seawater free of predator cue (this overall protocol thus yielded 2 conditioning exposures × 5 size classes × 2 cue treatments = 20 containers total). All 20 containers were then supplied with 20 juvenile mussel individuals each, as a basal food source for the carnivorous snails. This configuration created a 2 × 2 design stratified by size with conditioning history as one treatment and predator cue as the second treatment. We then measured the number of mussels consumed by the snails daily over the course of the next 15 days, without replacement of consumed mussels, along with the number of snails above or below the waterline within each container as a metric of anti-predatory escape behavior.

Further methods are detailed in Ng and Gaylord (2020). This dataset includes the behavioral and consumption data for *Nucella* during the feeding trials. Observations are taken once a day over a two-week period for 20 distinct containers. There are 4 treatment levels, which include a fully factorial combination of snails previously induced by crab cue or not and whether snails are exposed to crab cue during the feeding trial or not. The behavioral data involve noting the number of snails above the waterline (Out) or below/touching the waterline (In). In addition, we also noted the number of snails feeding on mussels at each time point, and if a mussel was consumed, what the size of the mussel was.

#### Known Issues:

There is a missing timestamp for the data collected on 2017-08-17.

## Data Processing Description

#### Data Processing:

All data were summarized using the aggregate function in R. The behavioral data were analyzed using a mixed-effects logistic model with containers as random effects and treatment type crossed with time. For mussel consumed data, a 2-way ANOVA was conducted with the two treatment types as factors.

#### BCO-DMO Processing:

- Converted dates to ISO date format (yyyy-mm-dd)
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Added a conventional header with dataset name, PI names, version date

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## Data Files

File
<b>for_bco-dmo_raw_nucella_behavior_data_with_mussel_size.csv</b> (Comma Separated Values (.csv), 13.37 KB) MD5:09b89dca65e94c2211d45ef0fabcfb76
Primary data file for dataset ID 869563

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## Related Publications

Ng, & Gaylord, B. (2020). The legacy of predators: persistence of trait-mediated indirect effects in an intertidal food chain. *Journal of Experimental Marine Biology and Ecology*, 530-531, 151416.  
<https://doi.org/10.1016/j.jembe.2020.151416>  
*Methods*

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## Related Datasets

### IsRelatedTo

Ng, G., Gaylord, B. (2022) **Data on whelk morphometrics from the Bodega Marine Laboratory, University of California, Davis in May-August of 2017**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-02-22 doi:10.26008/1912/bco-dmo.869574.1 [[view at BCO-DMO](#)]

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## Parameters

Parameter	Description	Units
Date	Date of observation in format: YYYY-MM-DD	unitless
Day	Day of observation since start of feeding trial	unitless
Time	Time of observation (AM/PM) in format: HH:MM	unitless
Container	container ID of snails during trial	unitless
Induced	Treatment identifier for snail prior predator exposure (Induced or Not Induced)	unitless
Crab	Treatment identifier for crab cue exposure during feeding trial	unitless
Out	Number of snails above the water line	Number of snails
In	Number of snails below or touching the water line	Number of snails
Feeding	Number of snails on a mussel	Number of snails
Mussels	Number of mussels consumed at that time point	Number of mussels
Mussel_size	Length of mussels	centimeters

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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
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1636191</a>

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