Data on whelk morphometrics from the Bodega Marine Laboratory, University of California, Davis in May-August of 2017.

Website: https://www.bco-dmo.org/dataset/869574
Data Type: experimental
Version: 1
Version Date: 2022-02-22

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

Contributors	Affiliation	Role
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Abstract
We conducted 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. This dataset represents morphometrics data of Whelks at the start and end of the experiment from the Bodega Marine Laboratory, University of California, Davis in May-August of 2017.

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Coverage

Spatial Extent: **Lat**:38.33325 **Lon**:-123.04805
Temporal Extent: 2017 - 2017

Methods & Sampling

We conducted 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 cue 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 cue 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 x 5 size classes x 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 water line within each container as a metric of anti-predatory escape behavior.

Further methods are detailed in Ng and Gaylord (2020). This dataset has the raw morphometrics of the whelks (Nucella) used in the experiment and includes wet weight and length of shell. The dataset includes morphometrics at the start of the experiment and repeated measures over time. In addition, the type of treatment the Nucella experienced is also included; in the control treatment, snails were exposed to just running seawater over the course of the experiment, and in the crab treatment, snails were exposed to *Cancer productus* cues. Snails were housed in multiple containers, which were used as random factors in the analysis. At the start of the experiment, snails were transferred from small containers (denoted as 'Container' in the dataset) into larger containers labeled as New.containers.

Data Processing Description

Data Processing:
The morphometrics was analyzed using a mixed-effects model with containers as random effects and both treatment type and type as factors. All data processing was conducted in R.

BCO-DMO Processing:
- 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	
legacy_of_predators_-_morphometrics.csv	(Comma Separated Values (.csv), 17.55 KB) MD5:72ed6dad58a3ba3f25532cbdf060ff98
Primary data file for dataset ID 869574	

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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) **Anti-predatory and foraging behaviors of whelks from laboratory experiments at Bodega Marine Laboratory in 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-16 doi:10.26008/1912/bco-dmo.869563.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
New_containers	Container ID in which snails were kept	unitless
Containers	Original container ID in which snails were kept but then moved	unitless
Size	Length of shell from tip to apertural notch	millimeters (mm)
Weight	Wet weight of Nucella	grams (g)
Month	Month in which measurement was taken	unitless
Treat	Treatment identifier for experiment (Control or Crab)	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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