

# Percent cover measure of mussel bed succession on rocky shores due to intra-population variation in dogwhelk drilling

**Website:** <https://www.bco-dmo.org/dataset/918518>

**Data Type:** Other Field Results, experimental

**Version:** 1

**Version Date:** 2024-01-24

## Project

» [Coastal mosaics of local adaptation and the eco-evolutionary dynamics of a marine predator-prey interaction](#)  
(Coastal Adaptation)

Contributors	Affiliation	Role
<a href="#">Sanford, Eric</a>	University of California-Davis (UC Davis-BML)	Principal Investigator
<a href="#">Longman, Emily K.</a>	University of California-Davis (UC Davis-BML)	Student
<a href="#">Rauch, Shannon</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

Despite growing interest of eco-evolutionary dynamics, there have been few experiments that test the importance of these feedbacks in natural ecosystems at the community level. A selection experiment on intra-population variation in dogwhelk (*Nucella canaliculata*) drilling was performed in the laboratory. Dogwhelks were given one of four early-life diet treatments (thin-shelled *Mytilus trossulus* mussels, two treatments of *M. californianus* from two populations known to differ in shell thickness, and acorn barnacles) for the first 3 months of life. Surviving adult dogwhelks were outplanted to field cages at Bodega Marine Reserve to test the ecological consequences of divergent phenotypes. Mussel bed succession was quantified by percent cover of sessile organisms in the plots over the course of approximately one year.

## Table of Contents

- [Coverage](#)
- [Dataset Description](#)
  - [Methods & Sampling](#)
  - [Data Processing Description](#)
  - [BCO-DMO Processing Description](#)
- [Data Files](#)
- [Supplemental Files](#)
- [Related Datasets](#)
- [Parameters](#)
- [Instruments](#)
- [Project Information](#)
- [Funding](#)

## Coverage

**Location:** Bodega Marine Reserve, California

**Spatial Extent:** **Lat:**38.323515 **Lon:**-123.078133

**Temporal Extent:** 2020-05-25 - 2022-08-29

## Methods & Sampling

To test the ecological consequences of phenotypic variation in dogwhelk drilling, *Nucella canaliculata* dogwhelks were outplanted to field cages and the effects on mussel bed succession were quantified as changes in percent cover of sessile species. In May of 2020, sixteen large plots of mid-intertidal mussel bed were cleared to bare rock at the Mussel Point site in Bodega Marine Reserve. The communities were left to naturally develop for a year until they were at a mid-successional stage. Stainless steel mesh cages with removable lids were then placed in the 16 areas in May of 2021. Cages were attached by bolting the cage to the rock and sealing

the edges with marine epoxy (Z-spar splash zone compound). Cages were in a block design with 5 cages placed in the 16 areas. In July of 2021, 5 adult dogwhelks were placed in each cage. Cages within each block received dogwhelks from the same family (dogwhelks from the same egg capsule cluster were considered a family of snails), with each cage getting dogwhelks from a given early-life diet treatment, plus one was a reference cage that did not get any dogwhelks. Mussel bed succession in the cages was quantified approximately every eight weeks for the next year (a total of 7 experimental checks, plus one check before the outplant of dogwhelks). The lids of the cages were removed, and photographs were taken of each plot. These photos are in the attached Supplemental File "Percent Cover Images.zip". Percent cover of sessile species was quantified from the photographs using image analysis by tracing polygons around individuals of a given species and dividing the total area by the area of the caged plot. Species were grouped into seven functional groups for analyses: bare rock, acorn barnacles, gooseneck barnacles, mussels, other sessile animals, coralline algae, and a final group of algae and surfgrass.

## Data Processing Description

ImageJ was used to analyze photos of the plots. Species were grouped into seven functional groups for analyses: bare rock, acorn barnacles, gooseneck barnacles, mussels, other sessile animals, coralline algae, and a final group of algae and surfgrass.

## BCO-DMO Processing Description

- Imported original file "Percent cover measure of mussel bed succession on rocky shores due to intra-population variation in dogwhelk drilling.xlsx" into the BCO-DMO system.
- Renamed fields/columns to comply with BCO-DMO naming conventions.
- Added columns for site Latitude and Longitude.
- Converted the Date column to YYYY-MM-DD format.
- Saved the final file as "918518\_v1\_pcmt\_cover\_mussel\_bed\_succession.csv".

[ [table of contents](#) | [back to top](#) ]

---

## Data Files

File
<b>918518_v1_pcmt_cover_mussel_bed_succession.csv</b> (Comma Separated Values (.csv), 98.99 KB) MD5:4150a2863d1b066560418e30e1fc2609
Primary data file for dataset ID 918518, version 1

[ [table of contents](#) | [back to top](#) ]

---

## Supplemental Files

File
<b>Percent_Cover_Images.zip</b> (ZIP Archive (ZIP), 1.76 GB) MD5:fad2f1e399122d397359f8b33613c899
Supplemental file for dataset ID 918518. This .zip file contains the photos of the field plots that were used to analyze percent cover.

[ [table of contents](#) | [back to top](#) ]

---

## Related Datasets

IsRelatedTo

---

Longman, E. K., Sanford, E. (2024) **Effect of phenotypic variation on dogwhelk morphology during an eco-evolutionary field experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-26 doi:10.26008/1912/bco-dmo.918546.1 [[view at BCO-DMO](#)]  
*Relationship Description: These datasets result from the same overarching project, in which Dogwhelks were raised on one of 4 diets for 3 months. A portion of the surviving dogwhelks were scored in the laboratory and another portion were outplanted to field cages for a year.*

Longman, E. K., Sanford, E. (2024) **Effects of early-life diet on Nucella canaliculata drilling phenotype quantified in the laboratory after rearing on different prey treatments.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-24 doi:10.26008/1912/bco-dmo.918460.1 [[view at BCO-DMO](#)]  
*Relationship Description: These datasets result from the same overarching project, in which Dogwhelks were raised on one of 4 diets for 3 months. A portion of the surviving dogwhelks were scored in the laboratory and another portion were outplanted to field cages for a year.*

Longman, E. K., Sanford, E. (2024) **Effects of early-life diet on mortality of juvenile Nucella canaliculata quantified in the laboratory after 3 months on experimental diets.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-24 doi:10.26008/1912/bco-dmo.918401.1 [[view at BCO-DMO](#)]  
*Relationship Description: These datasets result from the same overarching project, in which Dogwhelks were raised on one of 4 diets for 3 months. A portion of the surviving dogwhelks were scored in the laboratory and another portion were outplanted to field cages for a year.*

Longman, E. K., Sanford, E. (2024) **Effects of intra-population variation in dogwhelk drilling on the abundance and size of Mytilus californianus mussels.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-25 doi:10.26008/1912/bco-dmo.918582.1 [[view at BCO-DMO](#)]  
*Relationship Description: These datasets result from the same overarching project, in which Dogwhelks were raised on one of 4 diets for 3 months. A portion of the surviving dogwhelks were scored in the laboratory and another portion were outplanted to field cages for a year.*

Longman, E. K., Sanford, E. (2024) **Shell thickness of mussel recruits quantified in two species, Mytilus trossulus and Mytilus californianus.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-24 doi:10.26008/1912/bco-dmo.918420.1 [[view at BCO-DMO](#)]  
*Relationship Description: These datasets result from the same overarching project, in which Dogwhelks were raised on one of 4 diets for 3 months. A portion of the surviving dogwhelks were scored in the laboratory and another portion were outplanted to field cages for a year.*

[ [table of contents](#) | [back to top](#) ]

---

## Parameters

Parameter	Description	Units
Block	Block number. Plots were grouped into blocks such that 5 experimental plots were placed near each other. Each block contained dogwhelks from the same family, with each cage randomly assigned to contain snails from one of the four early-life diet treatments, plus a reference cage with no dogwhelks.	unitless
Plot_Number	Unique identifier for each plot.	unitless
Family	Families (dogwhelks from the same egg capsules cluster were considered to be full or half siblings and classified as a family) were given a unique identifier.	unitless
Site_Latitude	Latitude of the Bodega Marine Reserve field site.	decimal degrees
Site_Longitude	Longitude of the Bodega Marine Reserve field site (negative values = West).	decimal degrees
Treatment	Early-life diet treatment. Four treatments were used in this study: (1) a control diet of thin-shelled <i>M. trossulus</i> , (2) <i>M. californianus</i> from Soberanes Point, (3) <i>M. californianus</i> from Bodega Marine Reserve, and (4) acorn barnacles ( <i>Chthamalus dalli</i> ).	unitless
Family_x_Treatment	Each family by diet treatment was given a unique identifier.	unitless
Date	Date of experimental check.	unitless
Check	Check number. Cages were checked approximately every 8 weeks for the next year for a total of 8 experimental checks, including one check (0) completed before the snail outplant.	unitless
Bare_Rock	Percent cover of bare rock in plot.	percent (%)
Acorn_Barnacles	Percent cover of acorn barnacles in plot.	percent (%)
Mussels	Percent cover of mussels in plot.	percent (%)
Gooseneck_Barnacles	Percent cover of gooseneck barnacles in plot.	percent (%)
Other_Sessile_Animals	Percent cover of other sessile animals in plot.	percent (%)
Coralline_Algae	Percent cover of coralline algae in plot.	percent (%)
Algae_and_Surfgrass	Percent cover of algae and surfgrass in plot.	percent (%)

[ [table of contents](#) | [back to top](#) ]

## Instruments

<b>Dataset-specific Instrument Name</b>	Olympus Tough Tg-6 digital camera
<b>Generic Instrument Name</b>	Camera
<b>Dataset-specific Description</b>	Used to take photographs of each plot.
<b>Generic Instrument Description</b>	All types of photographic equipment including stills, video, film and digital systems.

## Project Information

### Coastal mosaics of local adaptation and the eco-evolutionary dynamics of a marine predator-prey interaction (Coastal Adaptation)

**Coverage:** Northeast Pacific coast; California and Oregon, USA

#### *NSF Award Abstract:*

Historically, ecologists regarded evolution as a process that typically acts slowly over very long time scales. However, recent studies suggest that evolution might also shape the way species interact over much shorter timespans, ranging from weeks to years. Are these sorts of rapid feedbacks between evolution and ecology important in marine ecosystems? This project will address this question along the Pacific coast of the United States by studying predatory snails (Channeled Dogwhelks) that feed on California Mussels, an important habitat-forming species on rocky intertidal shores. Prior research shows that some dogwhelk populations are composed of an assortment of individuals that differ genetically in how effectively they can drill through mussel shells. This project will test whether short-term changes in the environment can impose rapid natural selection that favors some of these drilling variants over others, altering the effects that a dogwhelk population has on the surrounding mussel bed. At the same time, this project will examine whether regional differences in mussel shell thickness have influenced the evolution of drilling ability among dogwhelk populations distributed along >900 kilometers of the California and Oregon coasts. Overall, this study seeks to understand the dynamic feedbacks between evolution and ecology that might influence marine communities in the face of changing ocean conditions. This project will train diverse undergraduate and graduate students and will provide the foundation for a significant public outreach component, including the production of accessible video documentaries.

This project seeks to advance our understanding of eco-evolutionary dynamics in the sea by investigating links among oceanographic variation, natural selection, species interactions, and community succession. This project will use the interaction between the Channeled Dogwhelk (*Nucella canaliculata*) and the California Mussel (*Mytilus californianus*) as a model system to address two central objectives. (1) The research team will explore how spatial mosaics of selection drive adaptive differentiation among populations of consumers. Newly collected and archived mussels will be analyzed to characterize variation in shell thickness along the coasts of California and Oregon, and to evaluate whether this spatial mosaic has been consistent or variable over the past two decades. Laboratory experiments will test whether dogwhelk populations distributed across this mosaic have diverged in the thickness of shell that they can drill successfully. (2) The research team will examine whether temporal variation in selection on consumer phenotypes shapes predator-prey interactions, with cascading effects on ecological dynamics. In particular, the project will test whether short-term variation in prey recruitment and shell thickness can impose rapid selection on the frequency of drilling phenotypes within a dogwhelk population. A field experiment will also test whether selection on these predator phenotypes in turn alters the trajectory of mussel bed succession.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1851462</a>