

# Effects of early-life diet on mortality of juvenile *Nucella canaliculata* quantified in the laboratory after 3 months on experimental diets

**Website:** <https://www.bco-dmo.org/dataset/918401>

**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
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## Abstract

The field of eco-evolutionary dynamics analyzes the reciprocal impacts that ecological and evolutionary processes have on one another on contemporary timescales. A promising approach for studying eco-evolutionary dynamics is to explore whether variation acting over rapid timescales can impose selection on existing within population-variation in functional traits. The Bodega Marine Reserve population of the Channeled Dogwhelk, *Nucella canaliculata*, contains a mix of drilling phenotypes. A selection experiment was performed to determine the effects 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) on *N. canaliculata* phenotype. Dogwhelks were hatched in the laboratory and mortality of juvenile dogwhelks was quantified in the laboratory after 3 months on the experimental diets.

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## Coverage

**Location:** Bodega Marine Reserve and Soberanes Point, California; and Bob Creek, Oregon

**Spatial Extent:** N:38.3235 E:-121.929 S:36.4476 W:-123.078

**Temporal Extent:** 2020-06-23 - 2021-03-11

## Methods & Sampling

Sets of *Nucella canaliculata* egg capsules were collected from Bodega Marine Reserve (n = 18) and Soberanes Point (n = 4) in 2020. The dogwhelks from Soberanes Point were used as a control because previous research showed that this population consists of individuals with strong drilling phenotypes and little variation among

individuals (Sanford & Worth 2009). Egg capsules from the same cluster were held together in laboratory tanks in mesh-sided containers and considered 'families' of dogwhelks. Dogwhelks were hatched at Bodega Marine Laboratory and dogwhelks from each family were split into four mesh-sided containers. For the first 3 weeks, all dogwhelks were fed a diet of thin-shelled *Mytilus trossulus* collected from Bob Creek, Oregon. Early life mortality of dogwhelks during this life stage can be very high (Spight 1975) so this time interval was necessary to prevent mortality from being too high, as this diet is known to result in high survival (Sanford & Worth 2009). After 3 weeks, all dogwhelks were switched to one of the four early-life diet treatments: a control diet of thin-shelled *M. trossulus*, *M. californianus* from Soberanes Point, *M. californianus* from Bodega Marine Reserve, or acorn barnacles (*Chthamalus dalli*). The two *M. californianus* treatments were meant to represent differences in shell thickness because preliminary research had shown that adult *M. californianus* from Bodega Marine Reserve have thicker shells than those from Soberanes Point. Containers were checked weekly to replace food and remove any dead dogwhelks. After 3 months on the experimental diets, total mortality was determined.

## BCO-DMO Processing Description

- Imported original file "Effects of early-life diet on mortality of juvenile Nucella canaliculata.xlsx" into the BCO-DMO system.
- Added columns for site Latitude and Longitude.
- Renamed fields/columns to comply with BCO-DMO naming conventions.
- Saved the final file as "918401\_v1\_juvenile\_nucella\_canaliculata\_mortality.csv".

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## Data Files

File
<b>918401_v1_juvenile_nucella_canaliculata_mortality.csv</b> (Comma Separated Values (.csv), 4.70 KB) MD5:d5cf2daaeb4925531b7aec43d261fcb0
Primary data file for dataset ID 918401, version 1

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## Related Publications

Sanford, E., & Worth, D. J. (2009). Genetic differences among populations of a marine snail drive geographic variation in predation. *Ecology*, 90(11), 3108–3118. <https://doi.org/10.1890/08-2055.1>  
*Methods*

Spight, T. M. (1975). On a Snail's Chances of Becoming a Year Old. *Oikos*, 26(1), 9.  
<https://doi.org/10.2307/3543270>  
*Methods*

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## 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 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) **Percent cover measure of mussel bed succession on rocky shores due to intra-population variation in dogwhelk drilling.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-24 doi:10.26008/1912/bco-dmo.918518.1 [[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.*

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## Parameters

Parameter	Description	Units
Family	Code/number to identify the family. Families (dogwhelks from the same egg capsules cluster were considered to be full or half siblings and classified as a family) from each population were numbered.	unitless
Population	Population that the dogwhelk egg capsule cluster was collected from: Bodega Marine Reserve (BMR) or Soberanes Point (SBR).	unitless
Site_Latitude	Latitude of the dogwhelk collection site.	decimal degrees
Site_Longitude	Longitude of the dogwhelk collection 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
Three_Month_Mortality	Mortality of dogwhelks after the 3 month selection phase on one of the experimental diet treatments of that family by diet treatment.	percent (%)

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## 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.

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## Funding

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

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