Effects of intra-population variation in dogwhelk drilling on the abundance and size of Mytilus californianus mussels

Website: https://www.bco-dmo.org/dataset/918582
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2024-01-25

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
Few eco-evolutionary studies have analyzed the impacts that evolutionary processes have on community dynamics in a natural field setting. We studied the effects of intra-population variation in predation in a marine dogwhelk (Nucella canaliculata) on mussel bed succession. We outplanted dogwhelks that were reared on four early-life diet treatments and showed evidence of differential mortality and variation in drilling capacity in the lab to experimental field cages and followed the trajectory of succession over the course of a year. At the end of the experiment, the organisms within the cages were collected and the mussels (Mytilus californianus) were measured. Mussels represent the end stage of succession, thus we studied whether variation in drilling traits would impact the size and structure of the mussel bed.

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Coverage

Location: Bodega Marine Reserve, California
Spatial Extent: **Lat**:38.323515 **Lon**:-123.078133
Temporal Extent: 2022-08-10 - 2022-08-29

Methods & Sampling

Dogwhelks (*Nucella canaliculata*) were reared in the laboratory on four early-life diet treatments for the first 3 months of life. In July of 2021, adult dogwhelks were outplanted to field cages (stainless steel mesh cages with removable lids that were bolted to the substrate) at Bodega Marine Reserve. The plots within the cages when the dogwhelks were outplanted were at a mid-successional stage, containing a mix of acorn barnacles, gooseneck barnacles, and a few small mussels. The cages were in a block design with five cages placed near each other. The dogwhelks outplanted to a given block were from the same family (dogwhelks from the same egg capsule cluster were referred to as a family of snails) with each cage getting dogwhelks that were reared on one of the four early life diet treatments, plus one cage was a reference cage that did not get any dogwhelks. The dogwhelks remained in the cages for the next year until August 2022 when the dogwhelks and

all of the mussels within the cages were collected and brought back to the laboratory. The organisms were sorted, the number of mussels present in each cage was counted, and their lengths (along the anterior to posterior axis) were measured. Very small mussels (<10 millimeters) were excluded, as these mussels were difficult to evaluate accurately.

BCO-DMO Processing Description

- Imported original file "Effects of intra-population variation in dogwhelk drilling on the abundance and size of Mytilus californianus mussels.xlsx" into the BCO-DMO system.
- Added columns for site Latitude and Longitude.
- Converted the Date column to YYYY-MM-DD format.
- Renamed fields/columns to comply with BCO-DMO naming conventions.
- Saved the final file as "918582_v1_abundance_size_m_californianus.csv".

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Data Files

File	
918582_v1_abundance_size_m_californianus.csv	(Comma Separated Values (.csv), 364.58 KB) MD5:9add63b90514b85559458cfc580d07f5
Primary data file for dataset ID 918582, version 1	

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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 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) **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
Block	Block number. Plots were in a block design such that 5 plots were near each other. Each block contained snails from the same family or egg capsule cluster, with each cage randomly assigned to contain snails from one of the four early-life diet treatments, plus a reference cage with no dogwhelks. Blocks were numbered sequentially.	unitless
Plot_Number	Unique identifier for each plot.	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
Date	Date that Mytilus californianus mussels within a given experimental cage were sorted and measured.	unitless
Length	Length of Mytilus californianus mussel held within a given experimental cage.	millimeters (mm)
Live_vs_Dead	Each Mytilus californianus mussel was noted as live (L) or dead (D).	unitless

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851462

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