Shell thickness of mussel recruits quantified in two species, Mytilus trossulus and Mytilus californianus

Website: https://www.bco-dmo.org/dataset/918420
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
Mussels are common on rocky shores along the west coast of North America and are prey to a number of species, including the Channeled Dogwhelk, Nucella canaliculata. When N. canaliculata hatch, they are dependent on a supply of newly recruited prey that are variable in abundance. To determine the strength of selection that early-life diet may impose on juvenile dogwhelks, recruit mussel shell thickness was quantified for two mussel species, Mytilus trossulus and Mytilus californianus. In addition, recruit M. californianus were collected from two locations, Bodega Marine Reserve and Soberanes Point, known to differ in the thickness of adult M. californianus.

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Coverage

Location: Bodega Marine Reserve and Soberanes Point, California; and Bob Creek, Oregon
Spatial Extent: **N**:44.244 **E**:-121.929 **S**:36.4476 **W**:-124.114
Temporal Extent: 2020-06-12 - 2021-03-11

Methods & Sampling

Recruit *Mytilus trossulus* mussels were collected from Bob Creek, Oregon. Recruit *M. californianus* were collected from Bodega Marine Reserve, California and Soberanes Point, California. Recruit mussel shell thickness comparisons were made for approximately 55 mussels per mussel type across the range of mussel sizes given to juvenile *N. canaliculata.* Mussel tissue was removed by incubating the mussels in 15% H2O2,

0.05 M NaOH with period agitation (Gaylord et al. 2018). The mussel shells were then dried to a constant weight and dry weights were measured on a microbalance. Pictures of the shells were taken using a camera (Leica MC170) attached to a dissecting microscope (Leica M125) and were used to calculate shell area and mussel length. These pictures are in the attached Supplemental File "Mussel Recruit Images.zip". Recruit mussel shell thickness was estimated as the total dry weight of both valves divided by the total projected area of both valves (Gaylord et al. 2018).

BCO-DMO Curation Notes

- Imported original file "Shell thickness of mussel recruits.xlsx" into the BCO-DMO system.
- Flagged "NA" as a missing data value (missing data are empty/blank in the final CSV file).
- Added columns for site Latitude and Longitude.
- Renamed fields/columns to comply with BCO-DMO naming conventions.
- Replaced commas with semi-colons in the "Notes" column.
- Saved the final file as "918420_v1_shell_thickness_of_mussel_recruits.csv"

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Data Files

File	
918420_v1_shell_thickness_of_mussel_recruits.csv	(Comma Separated Values (.csv), 18.15 KB) MD5:df84466443f53c1733987cf4a8d9f441
Primary data file for dataset ID 918420, version 1	

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Supplemental Files

File	
Mussel Recruit Images.zip	(ZIP Archive (ZIP), 593.51 MB) MD5:9beafe83afcddbe477ca3b241230192c
Supplemental file for dataset ID 918420. These images were used for the measurements of mussel length and area.	

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Related Publications

Gaylord, B., Rivest, E., Hill, T., Sanford, E., Shukla, P., Ninokawa, A., & Ng, G. (2018). California Mussels as Bio-indicators of Ocean Acidification. California's Fourth Climate Change Assessment. https://www.energy.ca.gov/sites/default/files/2019-12/Oceans_CCCA4-CNRA-2018-003_ada.pdf
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 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) **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.

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Parameters

Parameter	Description	Units
Mussel_Number	Mussel number.	unitless
Mussel_Type	Recruit mussel shell thickness was determined for three mussel types: (1) *Mytilus trossulus* (from Bob Creek, Oregon), (2) *M. californianus* collected from Bodega Marine Reserve (BMR), and (3) *M. californianus* collected from Soberanes Point (SBR).	unitless
Site_Latitude	Latitude of the mussel collection site.	decimal degrees
Site_Longitude	Longitude of the mussel collection site (negative values = West).	decimal degrees
Weight	Weight of both mussel valves.	grams (g)
Magnification	Magnification setting of Leica M125 dissecting microscope.	unitless
Length_L	Length of left mussel valve.	millimeters (mm)
Length_R	Length of right mussel valve.	millimeters (mm)
Area_L	Projected area of left mussel valve.	square millimeters (mm^2)
Area_R	Projected area of right mussel valve.	square millimeters (mm^2)
Total_Area	Total projected area of both mussel valves.	square millimeters (mm^2)
Shell_Thickness	Recruit mussel shell thickness; measured as total dry weight of both valves divided by the total projected area of both valves.	grams per square millimeter (g/(mm^2))
Notes	Notes about mussel number taken during estimate of shell thickness.	unitless

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Instruments

Dataset-specific Instrument Name	Leica MC170
Generic Instrument Name	Camera
Dataset-specific Description	Leica MC170: camera used to photograph recruit mussel shells.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Leica M125
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Leica M125: dissecting microscope used to photograph recruit mussel shells.
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Mettler Toledo XP2U
Generic Instrument Name	scale or balance
Dataset-specific Description	Mettler Toledo XP2U: Microbalance used to measure shell dry weight.
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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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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