Marine Community Composition of the Pacific Coast from June of 2022 to July of 2023

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Project
» OCE-PRF: Understanding substrate mobility as a disturbance in hard rock marine communities (PRF substrate mobility)

Contributors	Affiliation	Role
Cramer, Allison N	University of Washington (UW)	Principal Investigator
Carrington, Emily	University of Washington (UW)	Co-Principal Investigator
Garza, Corey	University of Washington (UW)	Co-Principal Investigator
Storlazzi, Curt	United States Geological Survey (USGS)	Co-Principal Investigator
Bible, Olivia	California State University Monterey Bay (CSU-MB)	Scientist
Cline, Cannon	Cornell University (Cornell)	Scientist
Leuchtenberger, Sara Grace	University of Washington (UW)	Scientist
Hopps, Evan	Arizona State University (ASU)	Student
Smith, Casey	University of Washington (UW)	Technician

Abstract
These data include community membership measurements collected from June 2022 to July 2023. Fine scale surveys collected biological data, measuring community membership via point sampling in quadrats. Data were collected to better understand the role of substrate mobility in structuring marine communities. These data were collected in tandem with data on substrate strength (N), which can be accessed separately. Collection was done by Dr. Alli Cramer, Olivia Bible, Canon Cline, Grace Leuchtenberger, and Casey Smith. Data cleaning and preparation was done by Evan Hopps.

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Coverage

Location: East Pacific, intertidal zones of the Salish Sea, Washington and Central to Southern California.
Spatial Extent: **N**:48.69187 **E**:-121.9031 **S**:36.52301 **W**:-123.1509
Temporal Extent: 2022-06-14 - 2023-07-17

Methods & Sampling

Marine Community

We sampled marine communities using point sampling in half-meter length (0.25m^2) quadrats. Quadrats were placed in a "T" shape, with the latitude and longitude coordinates of the site at the intersection of the T (see *T Shaped Survey Drawing).* The T shape was orthogonal to the orientation of the approaching waves - in other words

the cross bar was parallel to shore while the stem was pointing towards the waves. There were four quadrats on each spoke - four to the left side of the T, four on the stem, and four on the right side of the T.

For each quadrat, nylon rope was strung every 10 centimeters to create a grid with sixteen intersections that served as sampling points (see *Quadrat Organization Diagram*). At each point, we noted the marine organism(s) present at the location, using general functional groups such as 'limpet' and 'anemone'. Where possible, some organisms were identified to the species level; however that was not the intended purpose of the data collection so taxonomy was not prioritized. Organism size was measured as well using a plastic guide.

Data Processing Description

No pre-processing beyond data cleaning was performed on these data.

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Apple iPhone 13 camera
Generic Instrument Name	Camera
Dataset-specific Description	Images of the quadrats and sampling locations were taken with an Apple iPhone 13, Google Pixel 5, and Nikon Coolpix B500 cameras
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Google Pixel 5 camera
Generic Instrument Name	Camera
Dataset-specific Description	Images of the quadrats and sampling locations were taken with a Google Pixel 5, Apple iPhone 13, and Nikon Coolpix B500 cameras
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Nikon Coolpix B500 camera
Generic Instrument Name	Camera
Dataset-specific Description	Images of the quadrats and sampling locations were taken with an Apple iPhone 13, Google Pixel 5, and Nikon Coolpix B500 cameras
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	half meter quadrats
Generic Instrument Name	quadrat
Dataset-specific Description	Half-meter length (0.25 square meter) quadrats were placed in a "T" shape for the fine scale sampling location.
Generic Instrument Description	A square or rectangular rigid frame of known area, often home-made, that is placed on the substrate to be sampled to mark a fixed area for sampling flora or fauna.

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Project Information

OCE-PRF: Understanding substrate mobility as a disturbance in hard rock marine communities (PRF substrate mobility)

NSF Award Abstract

This award is funded in whole or in part under the American Rescue Plan Act of 2021 (Public Law 117-2).

Human actions impact marine ecosystems in a variety of ways, including shifting wave and current dynamics through global warming and altering the composition of the ocean floor. These changes, in turn, affect the location and distribution of marine communities. For soft-sediment communities, such as sandy beaches, the interaction between fluid forces and sediment disturbance is well understood. This allows scientists to measure sediment mobility and to create detailed predictions of the impact of human activities on these ecosystems. To date there are no measurements analogous to sediment mobility available for marine hard rock ecosystems. This research will investigate a potential measurement system which connects the forces of waves and currents to the resulting erosion of hard rock substrates and will test and evaluate how these disturbance patterns govern the distribution of communities themselves. By developing and testing this substrate mobility metric, this research will open new avenues of investigation for core ecological hypotheses. In addition, this work will allow managers, conservationists, and engineers to better predict the impact of human-generated change on hard rock marine communities. This project will also support the training and education of groups underrepresented in the geosciences through (1) field and data analysis experience via Research Experiences for Undergraduates summer programs, (2) professional development via mentoring relationships between the fellow and undergraduate trainees, and (3) the expansion of their professional network via cross-institutional coordination.

Disturbance, including fluid forces via waves on rocky shores, is well understood as a community organizing and structuring force. Foundational concepts within ecology, such as Connell's Intermediate Disturbance Hypothesis and Menge and Sutherland's Competition/Predation/Disturbance model, recognize that communities exist within a complex mosaic of physical and biological disturbance. This mosaic presents challenges when measuring disturbance regimes since the scales, causes, and consequences of disturbance vary between systems. However, in the marine environment, substrate mobility represents an explicit measure of disturbance impact present across marine ecosystems. This project will determine how to measure substrate mobility on hard substrates through collaboration with USGS geologists. In addition, this research will investigate a mechanism for disturbance via substrate mobility on benthic organisms through lab experiments and use field surveys to compare patterns of substrate mobility with the distribution of benthic communities and species functional groups. Explicitly quantifying the realized movement of hard substrate in response to fluid forcing integrates hard substrates into the already well understood sediment disturbance paradigm. This results in a universal framework of marine disturbance that is potentially revolutionary as it allows for comparative questions spanning a huge diversity of marine ecosystems, from coral reefs to the abyssal plain. This mechanistic framework provides a new connection between the disciplines of geomorphology and marine ecology.

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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