Counts of dead mussels, shell lengths of dead mussels, toxin data from LCMS, and histological results from mussel tissue from rocky intertidal sites on the Oregon coast in 2023 and 2024

Website: https://www.bco-dmo.org/dataset/994306
Data Type: Other Field Results
Version: 1
Version Date: 2026-03-03

Project
» RAPID: A subtle epidemic: unique mortality of Mytilus californianus on the Oregon coast (Scattered mussel mortality)

Program
» Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

Contributors	Affiliation	Role
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Abstract
This data set includes counts of dead mussels, shell lengths of dead mussels, toxin data from LCMS, and histological results from mussel tissue. Samples were collected in waters near study sites along the rocky intertidal on the Oregon coast. Study sites include: Fogarty Creek, Boiler Bay, Yachats Beach, Strawberry Hill, Tokatee Klootchman, Cape Blanco, Rocky Point, and Kibesillah Hill. Data were generated via field sampling and lab processing from 2023 to 2024. These data were collected to quantify the mortality pattern and attempt to determine the cause.

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Coverage

Location: Rocky intertidal on the Oregon coast
Spatial Extent: **N**:44.8444 **E**:-124.0718 **S**:44.2525 **W**:-124.12
Temporal Extent: 2023-08-01 - 2023-11-30

Methods & Sampling

Collection and analysis of "live" (unprocessed) water samples and separate preserved water samples for assessment of potential toxin-producing phytoplankton was done monthly. Samples were processed by Dr. Eli Meyer of Aquabiomics Inc. (Junction City, OR), by Dr. Ralph Elston of Aquatechnics (Carlsborg, WA), by Dr.

Maria Kavanaugh of OSU's College of Earth, Ocean, and Atmospheric Sciences (Seascape Ecology Lab), and Dr. Manuel Garcia-Jaramillo in the Department of Environmental and Molecular Toxicology at OSU.

Histology: To gain insight into mussel condition, in July 2023, twenty mussels from Fogarty Creek, ranging in shell length from 50 to 130 millimeters (mm) were examined histologically. We followed these with samples of five mussels each from five sites (FC, BB, YB, SH, and TK) in August, September, and October 2023 and June 2024. Mussels were dissected from their shells, preserved in formalin, and shipped to AquaTechnics Inc., in Sequim, Washington for processing. Sections were inspected for evidence of abnormal conditions of the digestive tubules and kidneys.

For LC-MS sampling, mussel tissue samples for the determination of toxin content using Liquid Chromatography-Mass Spectrometry (LC-MS) (King et al. 2021) (available in OSU's Mass Spectrometry center) were collected from September to December 2023. Sample size was 3 field sites (one per cape) x 3 mussels x 4 seasons = 36 mussels. Liquid chromatography was performed using an Acquity UPLC BEH C18 column (1.7 µm, 2.1 × 50 mm). Mobile phase A consisted of 6.7 mM ammonium hydroxide in water, and mobile phase B consisted of 6.7 mM ammonium hydroxide in acetonitrile. A 6-minute gradient method was used with the following conditions: 0–0.5 min, 70% A / 30% B; 3.5 min, 10% A / 90% B; and 4.1–6.0 min, 70% A / 30% B. The flow rate was 0.500 mL/min, the column temperature was maintained at 40 °C, and the injection volume was 3 µL. The retention time was 5.072 minutes.

Mass spectrometry was performed in negative ionization mode with a mass range of 50–1160 Da. Ion source gas pressures were set to 45 and 40 psi, the curtain gas pressure was 35 psi, the source temperature was 500 °C, the declustering potential was −80 V, the collision energy was −10 V, and the scan time was 0.518 s. An inclusion list containing yessotoxin (m/z = 1141.4700 Da) and 45-hydroxy-yessotoxin (m/z = 1157.4700 Da) was used. Instrument output consists of the intensity of the analyte m/z at its corresponding retention time. Extracted ion chromatograms (XICs) were generated by filtering the data by the target m/z values. Peaks in the XICs were integrated to obtain peak area, which was used to calculate analyte concentration based on the calibration curve.

A calibration curve was generated using standards at 10, 25, 50, 75, and 100 ppb. The limit of detection (LOD) and limit of quantification (LOQ) were determined using replicate injections of the 10 ppb standard. Using this method, all mussel sample extracts contained toxin concentrations below the LOD. Mussel tissue concentrations of yessotoxin were below 0.15 µg YTX/g mussel.

Histology and toxicology data are not spreadsheets but rather reports (see Supplemental Files). Relevant information is included in each report.

BCO-DMO Processing Description

2026-03-03: These data have been received and are currently being processed.

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	LC-MS
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Extracts were analyzed using liquid-chromatography coupled to high-resolution mass spectrometry (LC-HRMS). Data was acquired on a Sciex ExionLC ultrahigh performance liquid chromatography system coupled to a Sciex 7600 ZenoTOF high-resolution mass spectrometer.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	LC-MS
Generic Instrument Name	Ultra-high-performance liquid chromatography
Dataset-specific Description	Extracts were analyzed using liquid-chromatography coupled to high-resolution mass spectrometry (LC-HRMS). Data was acquired on a Sciex ExionLC ultrahigh performance liquid chromatography system coupled to a Sciex 7600 ZenoTOF high-resolution mass spectrometer.
Generic Instrument Description	Ultra high-performance liquid chromatography: Column chromatography where the mobile phase is a liquid, the stationary phase consists of very small (< 2 microm) particles and the inlet pressure is relatively high.

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Project Information

RAPID: A subtle epidemic: unique mortality of Mytilus californianus on the Oregon coast (Scattered mussel mortality)

Coverage: Rocky intertidal shores of Oregon and northern California

NSF Award Abstract:
On temperate rocky shores, mussels are a 'foundation' species, serving as prey for multiple predators, able to filter particles out of huge volumes of water, and harboring hundreds of other species, thereby serving a central role in community function. Hence, threats to their abundance and persistence are of significant ecological and societal concern. Past research has shown that mussels are highly resilient and well-adapted to acute, short-lived stresses such as disturbance from winter storms or short-term warming. In summer 2023, a novel pattern of mortality was discovered during routine field research: high numbers of dead mussels, many with tissue remaining in the shell were observed in a scattered pattern. That is, rather than a mass mortality (i.e., all mussels in a large area are killed), single dead mussels surrounded by live and apparently healthy mussels occurred, with multiple dead individuals per square meter. This project investigates the cause of the mortality event, which preliminary data suggests may be a harmful algal bloom. The project also builds capacity by supporting research training for several undergraduate students and informs the public and resource managers about an emerging threat to the stability of rocky intertidal ecosystems.

The hypothesis under investigation is that the 2023 'scattered' mortality event at 8 study sites along the Oregon and northern California coasts affecting the rocky intertidal dominant, *Mytilus californianus*, may be an unusual consequence of a harmful algal bloom. During this event, densities of dead mussels have ranged from 0.7 to 10.6/m2. This novel pattern contrasts with typical mass mortalities of organisms where all individuals within a specific site or area die due to (e.g.) thermal stress or severe storms. The scattered mortality pattern

persisted through late September 2023. Preliminary histological evidence suggests the ability of mussels to digest food is being suppressed, most likely by a water-borne toxin. To investigate the cause of the mortality event, the team is (1) collecting monthly (a) water samples for identification of dinoflagellate species and (b) mussel tissue samples for histological investigation of digestive and kidney tissues and high performance liquid chromatography and mass spectrometry analyses for the presence of algal-derived toxins; (2) continuing mussel bed surveys to determine the seasonality of the mortality event; and (3) quantifying mussel bed persistence through winter storms at sites with higher or lower rates of mortality. This research advances understanding of community responses to intense environmental stresses and how these might influence the future of rocky intertidal ecosystems.

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Program Information

Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

Website: http://www.piscoweb.org/

Coverage: West coast of North America from Mexico to Alaska

The Partnership for Interdisciplinary Studies of Coastal Oceans is a long-term ecosystem research and monitoring program established with the goals of:

- understanding dynamics of the coastal ocean ecosystem along the U.S. west coast
- sharing that knowledge so ocean managers and policy makers can make science based decisions regarding coastal and marine stewardship
- producing a new generation of scientists trained in interdisciplinary collaborative approaches

Over the last 10 years, PISCO has successfully built a unique research program that combines complementary disciplines to answer critical environmental questions and inform management and policy. Activities are conducted at the latitudinal scale of the California Current Large Marine Ecosystem along the west coast of North America, but anchored around the dynamics of coastal, hardbottom habitats and the oceanography of the nearshore ocean – among the most productive and diverse components of this ecosystem. The program integrates studies of changes in the ocean environment through ecological monitoring and experiments. Scientists examine the causes and consequences of ecosystem changes over spatial scales that are the most relevant to marine species and management, but largely unstudied elsewhere.

Findings are linked to solutions through a growing portfolio of tools for policy and management decisions. The time from scientific discovery to policy change is greatly reduced by coordinated, efficient links between scientists and key decision makers.

Core elements of PISCO are:

- Interdisciplinary ecosystem science
- Data archiving and sharing
- Outreach to public and decision-making user groups
- Interdisciplinary training
- Coordination of distributed research team

Established in 1999 with funding from The David and Lucile Packard Foundation, PISCO is led by scientists from core campuses Oregon State University (OSU); Stanford University’s Hopkins Marine Station; University of California, Santa Cruz (UCSC); and University of California, Santa Barbara (UCSB). Collaborators from other institutions also contribute to leadership and development of PISCO programs. As of 2005, core PISCO activities are funded by collaborative grants from The David and Lucile Packard Foundation and the Gordon and Betty Moore Foundation. Core support, along with additional funding from diverse public and private sources, make this unique partnership possible.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2346837

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