Temperatures from inside a mussel bed located at Argyle Creek on San Juan Island, WA, USA from 2019 to 2024

Website: https://www.bco-dmo.org/dataset/949773
Data Type: Other Field Results
Version: 1
Version Date: 2025-01-28

Project
» Collaborative Research: Microscale interactions of foundation species with their fluid environment: biological feedbacks alter ecological interactions of mussels (Microscale Mussels)

Contributors	Affiliation	Role
Nishizaki, Michael T.	Carleton College	Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes water temperature data measured at 30 minute intervals in a mytilid mussel bed (Mytilus spp.) by a HOBO Pendant MX logger (MX2201, Onset Computer Corporation, Bourne, MA). The site was located at Argyle Creek on San Juan Island, WA, USA from 2019 to 2024.

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Coverage

Location: Intertidal zone at Argyle Creek, San Juan Island, WA, USA
Spatial Extent: **Lat**:48.521791 **Lon**:-123.01417
Temporal Extent: 2019-06-26 - 2024-01-24

Methods & Sampling

This dataset contains ocean water temperatures recorded from the field to determine the range of temperatures experienced by mytilid mussels throughout the year. Temperatures were sampled from a mussel bed at Argyle Creek on San Juan Island, WA, USA (48.521791N, 123.01417W). The saltwater "creek" connects the ocean to a saltwater lagoon that fills at high tide and empties during low tide. As such, the creek experiences a range of water temperatures due to its tidal interactions with the lagoon. Water temperatures at this site were monitored because the mussels served as subjects for our lab-based physiological experiments. The focus of our lab experiments was on processes occurring during submersion, and mussels at this field site remain submerged.

Water temperatures were collected using a BlueTooth-capable HOBO logger (sampling frequency = 30 minutes; HOBO Tidbit MX2203; Onset, Bourne, MA) deployed from June 2019 to January 2024. Temperature sensor precision = 0.01C. The sensor was attached to the substratum by screwing it into a wall anchor in a concrete block (L x W x H = 40 cm x 40 cm x 5 cm). The HOBO remained submerged at all times.

Datetime and temperature data were offloaded from a sensor via Bluetooth connection to the HoboConnect monitoring app (Google Play store) on a Samsung Galaxy S21 phone. In MATLAB 24.2.0.2712019 (R2024b), columns were added for UTC datetimes, sampling location, latitude, and longitude. Times were recorded in PST and provided for comparison to local tide tables. UTC times are also provided to aid in any global comparisons. Sensor deployment and data analysis conducted by M. Nishizaki.

Organism identifiers:

Taxonomic name used in metadata, common name, Life Science Identifier (LSID)
Mytilus spp., mussel, urn:lsid:marinespecies.org:taxname:138228

Data Processing Description

Datetime and temperature data were offloaded from a sensor via Bluetooth connection to the HoboConnect monitoring app (Google Play store) on a Samsung Galaxy S21 phone. In MATLAB 24.2.0.2712019 (R2024b), columns were added for UTC datetimes, sampling location, latitude, and longitude.

Times were recorded in PST and provided for comparison to local tide tables. UTC times are also provided to aid in any global comparisons.

BCO-DMO Processing Description

* Data Table within submitted file "Mussel_bed_temperatures_2019_2024.csv" was imported into the BCO-DMO data system for this dataset. Table will appear as Data File: 949773_v1_mussel-bed-temps.csv (along with other download format options).

* ISO_Datetime_UTC column changed from datetime to datetime with timezone value by adding "Z" to represent UTC (as per 8601).

* LSID added for reference to mussel (Mytilus spp.) using the world register of marine species on 2025-02-18 LSID (urn:lsid:marinespecies.org:taxname:138228)

Problem Description

Data gaps are due to problems associated with deployment and/or sensor loss (June 2020 to Oct 2021 and August 2022 to June 2023).

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Data Files

File
949773_v1_mussel-bed-temps.csv (Comma Separated Values (.csv), 3.84 MB) MD5:0f2cb65a4bd63845dc087592a9095a12 Primary data file for dataset ID 949773, version 1

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Related Publications

MathWorks (2024), MATLAB version R2024b Documentation, The Mathworks, Inc. Retrieved from https://www.mathworks.com/help/releases/R2024b/index.html
Software

Onset Computer Corporation. (n.d.) HOBOconnect Monitoring App HOBOconnect | Onset’s HOBO Data

Loggers. Retrieved on Feb 18th, 2025 from https://www.onsetcomp.com/products/software/hoboconnect *Software*

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Parameters

Parameter	Description	Units
ISO_Datetime_UTC	Date and time with timezone (8601 format). Timezone Coordinated Universal Time (UTC) represented as "Z".	unitless
ISO_Datetime_PST	Date and time according to Pacific Standard Time (ISO 8601 format).	unitless
Location	name of the field site with mussel bed being monitored	unitless
Latitude	location of field site (latitude)	decimal degrees
Longitude	location of field site (longitude)	decimal degrees
Water_Temp	water temperature. Precision of temperature sensor = 0.01C	degrees Celcius (degC)

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Instruments

Dataset-specific Instrument Name	HOBO Tidbit MX2203 (Onset Computer Corporation, Bourne, MA)
Generic Instrument Name	Temperature Logger
Generic Instrument Description	Records temperature data over a period of time.

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Project Information

Collaborative Research: Microscale interactions of foundation species with their fluid environment: biological feedbacks alter ecological interactions of mussels (Microscale Mussels)

Coverage: University of Washington Friday Harbor Laboratories

NSF Award Abstract:
The project investigates how the metabolic activity of dense aggregations of marine organisms alter the water chemistry of their interstitial spaces, and how these microscale alterations feedback to affect the organisms' interactions in coastal ecosystems. The research team focuses on bivalve mussels, foundation species that form dense 'beds' typically known for facilitating other species by ameliorating harsh flow conditions. This ability can become a liability, however, if flow is not sufficient to flush the interstitial spaces and steep, metabolically-driven concentration gradients develop. The research evaluates whether corrosive chemical microclimates (such as low oxygen or low pH) are most extreme in low flow, high temperature conditions,

especially for dense aggregations of mussels with large biomass and/or high respiration rates, and if they negatively impact mussel beds and the diverse biological communities they support. The research addresses a global societal concern, the impact of anthropogenic climate change on coastal marine ecosystems, and has potential applications to aquaculture and biofouling industries by informing adaptation strategies to “future-proof” mussel farms in the face of climate change and improved antifouling practices for ships, moorings, and industrial cooling systems. The project forges new collaborations with investigators from three campuses and integrates research and education through interdisciplinary training of a diverse group of graduate, undergraduate and high school students. STEM education and environmental stewardship is promoted by the development of a K-12 level science curriculum module and a hand’s-on public exhibit of bivalve biology at a local shellfish farm. Research findings are disseminated in a variety of forums, including peer-reviewed scientific publications and research presentations at regional, national and international meetings.

The research team develops a framework that links environmental conditions measured at a coarse scale (100m-100km; e.g., most environmental observatories) and ecological processes at the organismal scale (1 cm – 10 m). Specifically, the project investigates how aggregations of foundation species impact flow through interstitial spaces, and how this ultimately impacts water chemistry immediately adjacent to the organisms. The research focuses on mytilid mussels, with the expectation that the aggregation alters the flow and chemical transport in two ways, one by creating a physical resistance, which reduces the exchange, and the other by enhancing the exchange due to their incurrent/excurrent pumping. These metabolically-driven feedbacks are expected to be strongest in densely packed, high biomass aggregations and under certain ambient environmental conditions, namely low flow and elevated temperature, and can lead to a range of negative ecological impacts that could not be predicted directly from coarse scale measures of ambient seawater chemistry or temperature. The team develops computational fluid dynamic (CFD) models to predict interstitial flows and concentration gradients of dissolved oxygen and pH within mussel beds. The CFD model incorporates mussel behavior and physiological activity (filtration, gaping, respiration) based on published values as well as new empirical work. Model predictions are compared to flow and concentration gradients measured in mussel aggregations in the laboratory and field. Finally, the team conducts several short-term experiments to quantify some of the potential negative ecological impacts of corrosive interstitial water chemistry on mussel aggregations, such as reduced growth, increased dislodgement, increased predation risk, and reduced biodiversity. Because the model is based on fluid dynamic principles and functional traits, the framework is readily adaptable to other species that form dense assemblages, thereby providing a useful tool for predicting the ability of foundation species to persist and provide desirable ecosystem services under current and future multidimensional climate scenarios.

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-2050129

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