Winter temperature data from loggers placed in shallow subtidal areas in the northeast Pacific from Oct 2019 to Jul 2024

Website: https://www.bco-dmo.org/dataset/949897
Data Type: Other Field Results
Version: 1
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Project
» Collaborative Research: Tracking fine-scale selection to temperature at the invasion front of a highly dispersive marine predator (West Coast Carcinus)

Contributors	Affiliation	Role
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Abstract
Dataset includes winter temperature logger data for a suite of embayments in the northeast Pacific. Data were collected as part of an NSF-funded project on invasive European green crab adaptation; loggers were placed in the shallow subtidal in areas determined by Washington Sea Grant's Crab Team to be good environments for green crabs. Loggers were placed by multiple collaborators without a fully standardized approach; metadata are incomplete but include all available information. Loggers used were iButtons and HOBO pendant loggers. Two loggers were placed at each site in the shallow subtidal with the goal that they were always submerged in water while deployed (i.e., not emersed). Logging frequency depended on the monitor type; iButtons captured water temperatures every 2.15 hours, and HOBO loggers recorded water temperature every 30 minutes over the winter. Deployment duration varied between years and sites, but typically ran from October - April.

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Coverage

Location: Northeast Pacific coast, shorelines of Washington state, Sooke Basin in British Columbia, and Seadrift Lagoon in California
Spatial Extent: **N**:48.9617611 **E**:-122.66786 **S**:37.90789 **W**:-124.67496
Temporal Extent: 2019-10-01 - 2024-07-16

Methods & Sampling

Loggers were placed in the shallow subtidal in areas determined by Washington Sea Grant's Crab Team to be good environment for green crabs. Loggers were placed by multiple collaborators without a fully standardized approach; metadata are incomplete but include all available information. Loggers used were iButtons (Maxim

Integrated; models DS1921G, DS1921Z, or DS1921G-F5) in 2019-2023, switching to HOBO loggers (Onset; model MX 2201) in 2022 (Makah Bay) or 2023 (all sites). iButtons were housed in waterproof housing capsules (DS9107), and both types of logger were placed within short lengths of PVC, which were open at both ends, to allow water flow but reduce temperature changes related direct light exposure, and any physical damage. Two loggers were placed at each site in the shallow subtidal, generally anchored on cinderblocks or pieces of PVC pushed into the substrate. Loggers were typically started before they were deployed in the field, sometimes weeks before, so include some air temperature data before deployment; metadata includes actual dates and times of deployment when known. Logging frequency varied by model: iButtons were set to log every 2.15 hours, and HOBOs logged every 30 min over the winter. Duration varied between years and sites, but typically ran from October - April. Loggers were generally not set to roll over (but see notes), and data were retrieved in the spring.

Data Processing Description

The raw .csv files were exported from HOBOware logger reading software. Files were not cleaned or trimmed, except as noted. A spreadsheet with all available metadata for deployments and retrievals was created.

BCO-DMO Processing Description

- Imported "BCO-DMO_temp-logger_metadata_NSF-1850996.csv" into BCO-DMO system
- Converted all dates to YYYY-MM-DD ISO 8601 format
- Replaced the following filenames with the corresponding filenames as they were submitted:
367.23-24.WinterB → 367.23.24.WinterB.csv
384.23-24.Winter.B → 384.23.24.WinterB.csv
385.23-24.WinterB → 385.23.24.WinterB.csv
367.23-24.Winter → 367.23.24.WinterA.csv
384.23-24.Winter → 384.23.24WinterA.csv
385.23-24.Winter → 385.23.24.WinterA.csv
- Imported 62 raw CSV files, normalizing for file format, value format, and precision
- Concatenated all the raw files into "wintertemp_all"
- Removed rows in "wintertemp_all" without temperature values that were produced when the logger was tracking other functions
- Converted datetimes for each type of date format (AM/PM, datetime with seconds, datetime without seconds) into ISO datetime format in "wintertemp_all"
- Converted measurement datetime to UTC in "wintertemp_all"
- Joined "wintertemp_all" with "BCO-DMO_temp-logger_metadata_NSF-1850996"
- Renamed fields to better represent values
- Exported file as "949897_v1_temp_logger_23_24"

Problem Description

Some loggers malfunctioned; these are noted in the supplemental file and no files are available. Also noted are recorded observations of movement or fouling of loggers which may impact the accuracy of recorded water temperatures.

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Parameters

Parameter	Description	Units
ISO_DateTime_UTC	Datetime (UTC) of measurement in ISO 8601 format	unitless

Local_DateTime	Datetime (local, Pacific Standard Time) of measurement in ISO 8601 format	unitless
Temperature	Water temperature	degrees Celsius
File_Name	Name of associated with original temperature data file	unitless
SiteNumber	WA Sea Grant code for site	unitless
SiteName	Site name	unitless
HabType	Habitat type	unitless
Type	Logger Brand	unitless
Model	Logger model number	unitless
SerialNumber	Individual logger serial number	unitless
LoggerStartDate	Date logger was started (local, Pacific Standard Time)	unitless
DeploymentDate	Date logger was deployed in the field (local, Pacific Standard Time)	unitless
DeploymentTime	Local Time logger was deployed in the field (local, Pacific Standard Time)	unitless
DeploymentDateTime	Local Datetime (local, Pacific Standard Time) logger was deployed in the field	unitless
Latitude	Latitude (decimal degrees), North is positive	decimal degrees
Longitude	Longitude (decimal degrees), East is positive	decimal degrees
DeployedBy	Person who deployed / retrieved the logger	unitless
RetrievalDate	Date logger was retrieved (local, Pacific Standard Time)	unitless
AnchorType	How logger was held in place in the shallow subtidal	unitless

TimeVar	Offset between logged time and actual time (measured at retrieval)	seconds
Notes	Any additional information on loggers or records	unitless

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Instruments

Dataset-specific Instrument Name	HOBO MX2201 loggers (Onset)
Generic Instrument Name	Onset HOBO Pendant MX2201 temperature logger
Dataset-specific Description	Loggers used were iButtons (Maxim Integrated; models DS1921G, DS1921Z, or DS1921G-F5) in 2019-2023, switching to HOBO loggers (Onset; model MX 2201) in 2022 (Makah Bay) or 2023 (all sites).
Generic Instrument Description	The Onset HOBO MX2201 is an in-situ instrument for wet or underwater applications. It supports soil temperature, temperature, and water temperature. A one-channel logger that records up to approximately 96,000 measurements or internal logger events with 8K bytes memory. It has a polypropylene housing case. Uses Bluetooth to transmit data. Can be used with a solar radiation shield. Measurement range: -20 deg C to 70 deg C. Accuracy: +/- 0.50 deg C from 0 deg C to 50 deg C. Water depth rating: 30.5 m

Dataset-specific Instrument Name	Thermochron iButton (Maxim) primarily model DS1921G
Generic Instrument Name	Water Temperature Sensor
Dataset-specific Description	Loggers used were iButtons (Maxim Integrated; models DS1921G, DS1921Z, or DS1921G-F5) in 2019-2023, switching to HOBO loggers (Onset; model MX 2201) in 2022 (Makah Bay) or 2023 (all sites).
Generic Instrument Description	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

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Project Information

Collaborative Research: Tracking fine-scale selection to temperature at the invasion front of a highly dispersive marine predator (West Coast Carcinus)

Coverage: North American west coast: 36 N to 51 N. Emphasis on the Salish Sea

NSF Award Abstract:
Marine invasive species pose a serious and ongoing risk to ocean ecosystems and the economies that rely on

them. Understanding how such species adapt rapidly to new environments is key to preventing and managing invasions. Traditionally, the focus has been on inherent traits and flexibility of an invasive species, ignoring the potential for evolutionary change after introduction. However, recent research has shown that some marine species may evolve specific genomic features which allow highly efficient selection over as little as a single generation. This project tests the importance of genomic traits in allowing marine invasive species to survive and thrive on new shores. Its focus is on the high-impact invasive European green crab, which has spread over 1,500 km of the West Coast of North America since 1989 and has very recently begun expanding into the Salish Sea. This project tracks the earliest stages of green crab invasion into a new environment where the species is predicted to have substantial ecological and economic impacts. Genetic differences are followed over time and space across the entire West Coast, with a focus on crabs found in the Salish Sea where the species is currently expanding. Genetic data is complemented by oceanographic modeling to predict the spread of green crabs into the Salish Sea and across the West Coast. Finally, targeted sequencing and prior sampling are used to probe the genomic traits underlying these changes and determine if the same traits have played a role in the species' invasive success on other shores. Sampling for this project is conducted by Washington Sea Grant's Crab Team, an expansive outreach and monitoring program powered largely by hundreds of volunteers who monitor green crabs across 3,000 miles of coastline in the Salish Sea. The results of this project are shared with these volunteers and other stakeholders and is used to inform trans-boundary green crab management and spread prediction on the West Coast.

Recent work has hypothesized that genomic architecture, which has been increasingly discovered to play a role in local adaptation, may also be key to a species' ability to adapt quickly when gene flow is high. This project integrates multiple approaches to track the speed and dynamics of adaptation-with-gene flow across a thermal gradient in an explicit oceanographic context using the invasive European green crab (Carcinus maenas). Prior work in this system identified a suite of genes that appear to constitute balanced polymorphisms whose allele frequencies correlate strongly with site temperature against a homogeneous neutral genetic background. This project has three main goals: 1) To examine fine-scale selection to temperature over a comprehensive spatial and temporal data set comprising most of the species' history on the West Coast, 2) To track the expanding range front in the Salish Sea, comparing the genetic trajectory of individuals at the range edge with oceanographic modeling of dispersal, and 3) To characterize the genomic regions surrounding putative balanced polymorphisms and examine the ubiquity of their association with temperature across globally replicated populations. This coupled evolutionary oceanography approach represents an unprecedented test of the speed and nature of rapid adaptation in a highly dynamic natural marine environment.

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-1850996
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