Water temperature data from temperature loggers attached to larval settlement collectors placed on the seafloor in the Gulf of Maine from from June to September 2023 (Lobster Thermal Thresholds project)

Website: https://www.bco-dmo.org/dataset/939856
Data Type: Other Field Results
Version: 1
Version Date: 2024-10-08

Project
» RUI: Collaborative Research: Linking physiological thermal thresholds to the distribution of lobster settlers and juveniles (Lobster Thermal Thresholds)

Contributors	Affiliation	Role
Annis, Eric R.	Hood College	Principal Investigator
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Rasher, Douglas B.	Bigelow Laboratory for Ocean Sciences	Co-Principal Investigator
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Abstract
We used the American lobster (Homarus americanus lsid:marinespecies.org:taxname:156134) in the Gulf of Maine as a model system to define thermal tolerance in larvae and establish mechanistic linkages between thermal tolerance of the individual larva and the patterns of settlement in the field. We assessed and compared the thermal tolerances of larvae in the laboratory and to link to patterns in the field we measured larval settlement as a function of depth (and therefore temperatures) and deployed caged larvae at different depths (and therefore temperatures). This dataset reports the bottom temperature data from temperature loggers attached to larval settlement collectors placed on the bottom from early June to late September in 2023. Collectors were deployed in coastal waters in the vicinity of Boothbay Harbor, Maine, USA at depths ranging from 7 to 77 meters. Bigelow Laboratory for Ocean Sciences were the base for field operations which were led by Eric Annis and Douglas Rasher.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
  - BCO-DMO Curation Notes
  - Problem Description
- Data Files
- Related Publications
- Parameters
- Instruments
- Project Information
- Funding

Coverage

Location: Bigelow Laboratory for Ocean Sciences
Spatial Extent: **N**:43.8453 **E**:-69.5025 **S**:43.6558 **W**:-69.7615
Temporal Extent: 2023-06-02 - 2023-09-29

Methods & Sampling

180 Larval settlement collectors were deployed for the 2023 *Homarus americanus* (lsid:marinespecies.org:taxname:156134) larval season to quantify settlement as a function of depth and temperature. Each collector was a 0.55 m2 rectangular cage with 0.15 m high sides filled with cobble stone (< 20 cm diameter). The wire mesh bottom of the cage was lined with 3 mm plastic mesh to retain newly settled lobsters on retrieval. Each collector had a temperature logger attached to the top to record bottom temperature for the duration of the deployment. The collectors were deployed in pairs with a single buoy and line to the surface. Collectors were deployed in the first week of June and retrieved in the last week of September.

Data Processing Description

Temperature data were downloaded through Bluetooth connection and converted to .csv files using the Onset HOBOware software. No further processing was conducted on the raw data provided here.

BCO-DMO Curation Notes

- This dataset originally followed an organizational pattern where separate variable-width plain text files were provided per each sensor used for data collection. These data files were merged into one csv, which is the primary data file for this dataset. This table contains a column showing the name of the original file from which a given row of data was concatenated, called Source_File.
- Deployment metadata was joined to the concatenated logger data file, including deployment date, time, latitude, longitude, and depth.
- A ISO_DateTime_UTC column was added to the primary data file from the Date and Time_Local_UTC4 columns.
- Original file names so they are all the same format. This change is reflected in the Source_File column of the Primary Data File.
- Standardized the Date and Time columns within the Primary Data file. The original files showed variability in date formats and Dates and Times vs Datetimes. All dates now follow a format of %Y-%m-%d.

Problem Description

We are not aware of any problems with the data that were retrieved. However, we were only able to successfully retrieve 114 of the 180 collectors deployed.

"LOST" within the column related to the date of retrieval indicates that the collector was not retrieved (i.e., recovered).

[table of contents | back to top]

Data Files

File	
939856_v1_2023_bottom_temperature_data.csv	(Comma Separated Values (.csv), 216.58 MB) MD5:4d22aff0513f14ccab5ecf896ca73cf7
Primary data file for dataset ID 939856, version 1	

[table of contents | back to top]

Related Publications

Wahle, R. A., Bergeron, C., Tremblay, J., Wilson, C., Burdett-Coutts, V., Comeau, M., Rochette, R., Lawton, P., Glenn, R., & Gibson, M. (2013). The geography and bathymetry of American lobster benthic recruitment as measured by diver-based suction sampling and passive collectors. Marine Biology Research, 9(1), 42–58. https://doi.org/10.1080/17451000.2012.727428

Parameters

Parameter	Description	Units
ISO_DateTime_UTC	Date time of the sensor reading from the data collector in UTC.	unitless
Ch1_Temperature	Temperature reading from the sensor of the data collector.	degrees C
Collector_ID	Sequential number given to each larval settlement collector. This corresponds to the collector number in the file name.	unitless
Temperature_Logger_ID	Serial number of the individual temperature logger in the collector. It is also included in the file name in corisponding the Source_File value.	unitless
Latitude	Latitude of logger deployment location in decimal degrees; a positive value indicates a northern coordinate.	decimal degrees
Longitude	Longitude of logger deployment location in decimal degrees; a negative value indicates a western coordinate.	decimal degrees
Datetime_deployed_UTC	Date time the data collector was deployed for data collection.	unitless
Date_Retrieved_UTC	The date that the collector and teperature logger were retrieved from the bottom. "LOST" in this field indicates that the collector was not retrieved.	unitless
Depth	Deployments were made from a commercial fishing vessel; depth data were recorded in fathoms and converted to meters.	meters (m)
Source_File	Original file name from which the corresponding row of data was sourced. Originally, the data were organized in discrete files per logger used, where each logger had a separate data file. These separate logger XLSX files have been merged to create the primary data file published through BCO-DMO.	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	MX2201, HOBO MX Pendant Temp
Generic Instrument Name	Onset HOBO Pendant MX2201 temperature logger
Dataset-specific Description	At sites greater than 20 meters in depth, Onset HOBO MX Pendant (MX2201) temperature sensors, set to ten-minute sample intervals were used.
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	MX2203, HOBO MX TidbiT 400
Generic Instrument Name	Onset HOBO Pendant Temperature/Light Data Logger
Dataset-specific Description	At sites greater than 20 meters in depth, HOBO MX TidbiT 400 (MX2203) set to ten-minute sample intervals were used.
Generic Instrument Description	The Onset HOBO (model numbers UA-002-64 or UA-001-64) is an in-situ instrument for wet or underwater applications. It supports light intensity, soil temperature, temperature, and water temperature. A two-channel logger with 10-bit resolution can record up to approximately 28,000 combined temperature and light measurements with 64K bytes memory. It has a polypropylene housing case. Uses an optical USB to transmit data. A solar radiation shield is used for measurement in sunlight. Temperature measurement range: -20 deg C to 70 deg C (temperature). Light measurement range: 0 to 320,000 lux. Temperature accuracy: +/- 0.53 deg C from 0 deg C to 50 deg C. Light accuracy: Designed for measurement of relative light levels. Water depth rating: 30 m.

[table of contents | back to top]

Project Information

RUI: Collaborative Research: Linking physiological thermal thresholds to the distribution of lobster settlers and juveniles (Lobster Thermal Thresholds)

Coverage: Gulf of Maine

NSF Award Abstract:
Temperature is one critical factor that determines the distribution of marine organisms. However, in many cases temperature ranges (thermal tolerances) are only known for adults, but not for the immature stages that transition from the plankton to the bottom. This study is testing how temperature affects where larvae are settling. The American lobster (Homarus americanus) in the Gulf of Maine is serving as a model system to measure the thermal tolerance of the larvae and link this to the distribution of young lobsters in the field. Presently, lobster larvae are more likely to experience relatively cold temperatures than heat stress and larval settlement appears to be restricted to warmer shallow waters by a sensitivity to temperatures below 12°C. As water temperature has increased, settlement and juvenile distribution have expanded into deeper waters suggesting a release from cold stress. This project is advancing the understanding of shifting species

distributions in response to increasing ocean temperatures by exploring thermal sensitivity in wild-caught larvae for the first time. This information is providing thermal thresholds for modeling larval viability in response to climate change scenarios. Understanding the larvae?s responses to temperature is fundamental to predicting the impact of climate change on one of the most valuable commercial fisheries in North America. The project is supporting training of undergraduate interns and a master?s student from small colleges (Hood College and University of New England) and connecting them with a research institution (Bigelow Laboratory for Ocean Sciences). Teacher training is occurring in collaboration with the Marine Science Center at the University of New England. Results from this study are being shared with stakeholders and contributing to science-based management of the lobster fishery.

This project is the first to examine how thermal stress on a larval stage determines juvenile distributions using a combination of correlative and experimental approaches that includes measuring biochemical stress indicators in larvae deployed in natural field habitats. The central hypothesis is that the physiology of individual planktonic larvae controls meso-scale settlement patterns in the field. The goal is to ascertain if there is a causal relationship between the underlying physiology and thermal sensitivity of the organism and the distribution of early life stages. Larval supply, settlement and juvenile abundances will be assessed at different depths with temperatures above and below the proposed minimum temperature threshold of 12°C for larvae. Laboratory experiments using conventional methods are determining thermal tolerances in wild-caught larvae and how they change with ontogeny. The upper and lower thermal optima are being resolved using multiple physiological parameters such as measurements of oxygen consumption and aerobic scope, and biochemical assays of thermal stress (HSP70, AMPK, and SIRT). To link physiology to settlement patterns, caged stage IV larvae and V juveniles are being deployed in the field at sites with temperatures above and below 12°C. Lethal and sub-lethal effects on caged lobsters are being evaluated through measures of growth, mortality and biochemical markers of thermal stress. This is the first study to focus on the thermal tolerance of wild larvae, which has broad implications for understanding settling in marine invertebrate larvae.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1948146
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947639
NSF Division of Ocean Sciences (NSF OCE)	OCE-1948108

[table of contents | back to top]