Salinity data collected from near-bottom HOBO logger placed in oyster beds in the Delaware Bay Apr 2021 to Nov 2021 (SEGO project)

Website: https://www.bco-dmo.org/dataset/945362
Data Type: Cruise Results, Other Field Results
Version: 1
Version Date: 2024-12-10

Project
» Collaborative Research: Spatial analysis of genetic differences in salinity tolerance resulting from rapid natural selection in estuarine oysters (SEGO)

Contributors	Affiliation	Role
North, Elizabeth	University of Maryland Center for Environmental Science (UMCES/IMET)	Principal Investigator
Howlader, Archi	University of Maryland Center for Environmental Science (UMCES/IMET)	Scientist
Mickle, Audrey	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Salinity data was collected at three stations (Hope Creek, Cohansey, and New Beds) in the Delaware River from May to November, 2021 as part of the Selection along Estuarine Gradients in Oysters (SEGO) project. Data loggers were suspended near-bottom and swapped out monthly to provide a timeseries of near-bottom salinity at the three stations. Dr. Daphne Munroe led the collection of this data on the research cruise conducted by Rutgers University on the R/V Bivalve. This dataset was curated by graduate student Archi Howlader who used it to validate empirical model predictions of salinity at these stations.

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Coverage

Location: Delaware Bay, USA
Spatial Extent: **N**:39.5442 **E**:-75.248 **S**:39.248 **W**:-75.5165
Temporal Extent: 2021-04-27 - 2021-11-17

Methods & Sampling

Field measurements of salinity were collected as part of the Selection along Estuarine Gradients in Oysters (SEGO) project. HOBO Saltwater Conductivity Data Loggers (HOBO U24-002-C) were fixed to a frame and suspended in the water about 5-10 cm off the bottom from May to November 2021 at the Hope Creek, Cohansey, and New Beds stations (Manuel 2022). These data loggers stored measurements of conductivity and temperature every 15 minutes. Sensors were swapped out on a monthly basis during summer and a calibrated YSI sensor was used to take measurements near the sensor in situ to check sensor accuracy upon deployment and retrieval. Data loggers at the Cohansey station were lost halfway through the deployment period. Data were formatted for analysis and screened for instrument malfunctions and fouling problems. This field data was important for model validation because it was collected after the dredging was complete in the Delaware River navigational channel (conducted from 2012 and 2018) that could have affected the salinity regime. Daphne Munroe and Jenn Gius at Rutgers University conducted the field sampling.

In the SEGO dataset, biofouling and sediment deposition on HOBO sensors influenced the accuracy of the salinity measurements, likely because sensors were deployed only 5-10 cm above the oyster beds. Inspection of time series plots, comparison of data with YSI sensors, and comparison of data with freshwater discharge records were conducted, similar to the quality assurance methods for the ACOE dataset. Sensor fouling was a more significant problem than in the ACOE dataset (see related datasets), with 35%, 8%, and 57% of data being discarded at Hope Creek, Cohansey, and New Beds stations, respectively. Archi Howlader at University of Maryland Center for Environmental Science conducted the data curation (Howlader 2022).

Data Processing Description

Data curation was conducted on the SEGO datasets to prepare it for analysis. All of the null values were removed. In addition, salinity was calculated from temperature and specific conductivity using the wql package with R version 4.0.3 (Jassby, 2017, downloaded 2020; R Core Team, 2020). This code was also used in Hill et al. (1986). The time stamps in all datasets were converted to (UTC/GMT).

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BCO-DMO Processing Description

- imported both raw and processed data sheets from each location file "NewBed_Field Data_Sensor134.xlsx", "HopeCreek_Field Data_Sensor 132_.xlsx", "Cohansey_Field Data.xlsx" into BCO-DMO system
- converted dates to include "Z" - %Y-%m-%dT%H:%M:%SZ
- joined raw and process data on collection datetime
- added station name, lat, and lon for each location referenced
- removed local datetime field, leaving ISO UTC field
- concatenated all locations into one dataset with all raw and processed values by collection datetime
- exported dataset as "945362_v1_salinity_delaware_river_2021.csv"

Problem Description

In the SEGO dataset, biofouling and sediment deposition on HOBO sensors influenced the accuracy of the salinity measurements, likely because sensors were deployed only 5-10 cm above the oyster beds. Sensor fouling was a significant problem, with 35%, 8%, and 57% of data being discarded at Hope Creek, Cohansey, and New Beds stations, respectively.

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Data Files

File
945362_v1_salinity_delaware_river_2021.csv (Comma Separated Values (.csv), 2.81 MB) MD5:ff0d78625a138d2fbd8b6e8192320c7a Primary data file for dataset ID 945362, version 1

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Related Publications

Hill, K., Dauphinee, T., & Woods, D. (1986). The extension of the Practical Salinity Scale 1978 to low salinities. IEEE Journal of Oceanic Engineering, 11(1), 109–112. https://doi.org/10.1109/joe.1986.1145154 https://doi.org/10.1109/JOE.1986.1145154
Methods

Howlader, A., North, E. W., Munroe, D., & Hare, M. P. (2024). Hindcasting Estuarine Bottom Salinity Using Observing Systems Data and Nonlinear Regression, as Applied to Oysters in Delaware Bay. Estuaries and Coasts, 47(8), 2341–2359. https://doi.org/10.1007/s12237-024-01396-x
Results

Howlader, Archi (2022). Predicting the Salinity History of Oysters in Delaware Bay Using Observing Systems Data and Nonlinear Regression. *Digital Repository at the University of Maryland*. https://doi.org/10.13016/CRJQ-2VKB https://doi.org/10.13016/crjq-2vkb
Results

Jassby, A. (2017). wql: Exploring Water Quality Monitoring Data [dataset]. In CRAN: Contributed Packages. The R Foundation. https://doi.org/10.32614/cran.package.wql https://doi.org/10.32614/CRAN.package.wql
Software

Manuel, E. C., Hare, M. P., & Munroe, D. (2023). Consequences of Salinity Change, Salinity History, and Shell Morphology on Early Growth of Juvenile Oysters. Journal of Shellfish Research, 42(1). https://doi.org/10.2983/035.042.0103
Methods

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Related Datasets

IsRelatedTo

North, E., Howlader, A. (2024) **Salinity data collected by the Army Corps of Engineers (ACOE) from near-bottom sondes placed in oyster beds in the Delaware Bay from 2012 to 2018 (SEGO project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-12-09 http://lod.bco-dmo.org/id/dataset/945381 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
ISO_DateTime_UTC	Day and time (UTC) of raw and processed measurement	unitless
Station	Name of oyster bed station	unitless
Latitude	Latitude of oyster bed station	decimal degrees
Longitude	Longitude of oyster bed station	decimal degrees
Conductivity	Conductivity measurement from logger	microsiemens per centimeter (uS/cm)
Temperature	Temperature measurement from logger	degrees Celsius
Salinity	Curated salinity measuerment (psu)	psu

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Instruments

Dataset-specific Instrument Name	HOBO Saltwater Conductivity Data Loggers (HOBO U24-002-C)
Generic Instrument Name	Conductivity Meter
Dataset-specific Description	HOBO Saltwater Conductivity Data Loggers (HOBO U24-002-C) were fixed to a frame and suspended in the water about 5-10 cm off the bottom from May to November 2021 at the Hope Creek, Cohansey, and New Beds stations (Manuel 2022).
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

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Project Information

Collaborative Research: Spatial analysis of genetic differences in salinity tolerance resulting from rapid natural selection in estuarine oysters (SEGO)

Coverage: Delaware Bay, NJ side of channel: 39.43 N, -75.50 W to 39.14 N, -75.14 W

NSF abstract:

Many marine animals have a bipartite life cycle consisting of a stationary bottom-dwelling adult stage and a mobile larval stage. The flow of water transports these larval offspring, and their genes, to different habitat patches. It is thought that animals from nearby patches will be more genetically similar than animals in patches that are further in proximity, but these patterns of genetic similarity may not be maintained if the nearby patches have different habitat characteristics. This idea is fundamental to our understanding of adaptation and evolution, but it has not been adequately tested with respect to the effects of rapid selection. This study applies new technologies to test if the genetic signatures of marine animals change even when patches with different environmental characteristics are closer together than the dispersal distance of larvae. This research focuses on eastern oysters (Crassostrea virginica) in Delaware Bay, and their ability to withstand variability in the amount of salt in the water. This study will provide new insights on factors that control oyster survival and growth in estuaries with different salinity profiles. The three investigators are sharing study results with resource managers and stakeholders to improve shellfish restoration and oyster stock management in Delaware Bay, Chesapeake Bay, and New York. A postdoctoral scholar at Cornell and graduate student at the University of Maryland are being trained and mentored during the project. The investigators are also working with teacher training programs in New York and New Jersey to develop and disseminate new curriculum materials on oyster ecology for middle-school students.

The project will investigate whether hyposalinity tolerance of oysters is a function of viability selection during larval dispersal and after settlement. Gene flow across salinity zones within an estuary is expected to be high enough that adaptive differentiation will not result from Darwinian multigenerational processes. Instead, recurrent viability selection in each generation is expected to generate spatial variation in this trait at small spatial scales. This type of recurrent within-generation adaptation has been referred to as phenotype-environment mismatches and has been hypothesized to generate balanced polymorphisms, but it has never been studied beyond single gene cases. The project team is testing for spatially discrete patterns of selection by first collecting oysters from different salinity zones, measuring variation in their tolerance to low salinity and then testing for associations between this trait and genomic variation using whole genome sequencing. Experimental hyposalinity challenges enable within-generation, before/after genomic comparisons to identify DNA variants that change as a result of strong viability selection. Candidate genes and selectively neutral control loci will be assayed in larval, juvenile, and adult samples from the same salinity zones to test for an association between variation at candidate loci and lifetime hyposalinity exposure. Two years of environmental data will be collected and added to an existing long-term data set to map salinity variation. The observed spatial distribution of hyposalinity tolerance and genomic variation associated with it provide a test that could definitively reject the prevalent assumption that all larvae have similar capabilities. If larvae differ by parental source for traits that differentially affect their viability in the plankton, then phenotype-environment mismatches can have profound consequences for population connectivity. This project improves understanding about mechanisms that shape realized larval dispersal and recruitment variation in oyster populations.

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-1756592

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