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)

Website: https://www.bco-dmo.org/dataset/945381
Data Type: Cruise Results, Other Field Results
Version: 1
Version Date: 2024-12-09

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

Contributors	Affiliation	Role
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Abstract
The data in this dataset was originally collected by the Army Corps of Engineers (ACOE) and was curated for use in the Selection along Estuarine Gradients in Oysters (SEGO) project. Quoting Howlader (2022): “This dataset was collected in response to the deepening of the Delaware River navigational channel. The dataset has continuous near-bottom (1 m off the bottom) measurements of temperature and specific conductivity taken every 30 minutes at the five oyster bed stations from July-December in 2012-2015 and 2018 using a YSI series 6600EDS V2 data sondes (Bromilow & Wong 2018; Bushek et al. 2014, 2015, 2016). Data sondes were swapped once per month. The depth of water at the monitoring stations were 5-8 meters (Bushek et al. 2014, 2015, 2016).” The dataset includes salinity values expressed alongside corresponding datetime (UTC/GMT), station name, latitude, and longitude. The data was curated by removing anomalous values, shifting the data by the tidal basis to align it with data from Reed Point.

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Coverage

Location: Delaware Bay, USA
Spatial Extent: **N**:39.442 **E**:-75.248 **S**:39.248 **W**:-75.5165
Temporal Extent: 2012-06-05 - 2018-12-05

Methods & Sampling

Data collection information from Howlader (2022) “The dataset has continuous near-bottom (1 m off the

bottom) measurements of temperature and specific conductivity taken every 30 minutes at the five oyster bed stations from July-December in 2012- 2015 and 2018 using a YSI series 6600EDS V2 data sondes (Bromilow & Wong 2018; Bushek et al. 2014, 2015, 2016). Data sondes were swapped once per month. The depth of water at the monitoring stations were 5-8 meters (Bushek et al. 2014, 2015, 2016).”

Data Processing Description

Data curation was conducted on the ACOE datasets to prepare them for analysis (Howlader 2022). All null values were removed and time stamps were converted to the same time zone (UTC/GMT). Comparison datasets used include Station USGS 01482800 Delaware River at Reedy Island Jetty, New Castle County, station USGS 01463500 Delaware River at Trenton, NJ, and Brandywine Shoal Light, NOAA Station ID: 8555889.

Methods description from Howlader (2022):

"Potential instrument malfunctions and fouling problems were investigated in the ACOE dataset. Graphs of daily average salinity at an oyster bed station versus daily average salinity at Reedy were created and visually inspected to identify erroneous measurements caused by sensor malfunction or fouling. Visual inspection revealed that several hundred data points (0.8% of total data set) were substantially lower than most of the data and fell below the 95% prediction interval when a nonlinear model was fit to the data. To determine if these data points were the result of instrument malfunctions or fouling, these data points were plotted against time. Plots (not shown) showed sudden changes in salinity or gradual, linear increases in salinity measurements near the end of a deployment indicative of sensor fouling. To ensure that the anomalous data were due to instrument malfunctions and sensor fouling and not the result of sudden changes in freshwater flow or wind, both freshwater (from station USGS 01463500 Delaware River at Trenton, NJ) and wind (Brandywine Shoal Light, NOAA Station ID: 8555889) data were used. The data were formatted, null values were removed, and data was plotted on the same graph as salinity data to confirm that there were no significant high discharge events coincident with the anomalous salinity observations. Hourly wind data from June-December of 2012 2013, 2014, 2015, and 2018, were likewise plotted with salinity to confirm that there were no strong wind events during the times of the anomalous salinity observations. These analyses demonstrated that the salinity anomalies were most likely a result of sensor fouling and those observations were therefore removed from the dataset."

After removing anomalous data, the data shifted according to the tidal basis using the R package HelpersMG (Girondot, 2015) (from Howlader 2022):

"Each of the ACOE and Haskin time series were shifted by the tidal phase lag and aligned in time to prepare the time series for analysis. Because the Reedy, Hope Creek, Arnolds, Cohansey, Shell Rock, and New Beds stations were located along a transect from upper to lower bay, and the tidal wave progresses from lower to upper bay, the peak in salinity during a tidal period occurred at different times at each station. Shifting the time series by the tidal phase lag corrected this difference. First, the "tide.info" function of the HelpersMG package in R was used to predict the tidal heights (m) at Reedy and the oyster bed stations. The time series of tidal heights were then graphed, and the time difference between peaks (i.e., the tidal phase lag) was calculated. This difference was used to adjust the time series of salinity at the oyster bed stations."

BCO-DMO Processing Description

- imported data from all five location sheets containing corrected data from "Curated ACOE Data.xlsx" into BCO-DMO system
- added station name, lat, and lon for each location referenced
- concatenated all sheets into one dataset
- converted dates to include "Z" - %Y-%m-%dT%H:%M:%SZ
- exported dataset as "945381_v1_acoe_salinity_delaware_bay_2012-2018.csv"

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Related Publications

Bromilow, A.M., and D. Wong. 2018. Turbidity monitoring report for Upper Reach E Delaware River Main Channel Deepening Project 2017. Report to U.S. Army Corps of Engineers, Philadelphia, PA, p. 24.
Methods

Bushek, D., J. Morson, D. Wong, J. Dew-Baxter, D. Kreeger, and W.H. Burton. 2014. Oyster and water quality study for the Delaware River Main Channel Deepening project, 2013. Report to U.S. Army Corps of Engineers, Philadelphia, PA, p. 141.
Methods

Bushek, D., J. Morson, D. Wong, J. Dew-Baxter, D. Kreeger, and W.H. Burton. 2015. Oyster and water quality study for the Delaware River Main Channel Deepening project, 2014. Report to U.S. Army Corps of Engineers, Philadelphia, PA, p. 144.
Methods

Bushek, J., D. Morson, C.D. Wong, D.D. Kreeger, R. Thomas, and W.H. Burton. 2016. Oyster and water quality study for the Delaware River Main Channel Deepening project, 2015.
Methods

Girondot, M. (2015). HelpersMG: Tools for Environmental Analyses, Ecotoxicology and Various R Functions [dataset]. In CRAN: Contributed Packages. The R Foundation. https://doi.org/10.32614/cran.package.helpersmg https://doi.org/10.32614/CRAN.package.HelpersMG
Software

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

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Related Datasets

IsRelatedTo

North, E., Howlader, A. (2024) **Salinity data collected from near-bottom HOBO logger placed in oyster beds in the Delaware Bay Apr 2021 to Nov 2021 (SEGO project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-12-10 doi:10.26008/1912/bco-dmo.945362.1 [view at BCO-DMO]

Methods

Brandywine Shoal Light, NOAA Station ID: 8555889. NOAA Tides & Currents.https://tidesandcurrents.noaa.gov/stationhome.html?id=8555889

Station USGS 01463500 Delaware River at Trenton, NJ. U.S. Geological Survey, National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), https://waterdata.usgs.gov/monitoring-location/01463500/.

Station USGS 01482800 Delaware River at Reedy Island Jetty, New Castle County. U.S. Geological Survey, National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), https://waterdata.usgs.gov/monitoring-location/01482800/

United States Geological Survey. *USGS Water Data for the Nation*. U.S. Geological Survey. https://doi.org/10.5066/F7P55KJN

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Parameters

Parameter	Description	Units
DATETIME	Day and time (UTC) of curated salinity measurement	uniteless
Salinity	Curated salinity measuerment (psu) that was shifted by the tidal basis to match the tidal stage at Reedy Point	psu
Station	Name of oyster bed station	unitless
Latitude	Latitude of oyster bed station	decimal degrees
Longitude	Longitude of oyster bed station	decimal degrees

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Instruments

Dataset-specific Instrument Name	YSI series 6600EDS V2 data sonde
Generic Instrument Name	YSI Sonde 6-Series
Dataset-specific Description	The dataset has continuous near-bottom (1 m off the bottom) measurements of temperature and specific conductivity taken every 30 minutes at the five oyster bed stations from July-December in 2012- 2015 and 2018 using a YSI series 6600EDS V2 data sondes
Generic Instrument Description	YSI 6-Series water quality sondes and sensors are instruments for environmental monitoring and long-term deployments. YSI datasondes accept multiple water quality sensors (i.e., they are multiparameter sondes). Sondes can measure temperature, conductivity, dissolved oxygen, depth, turbidity, and other water quality parameters. The 6-Series includes several models. More from YSI.

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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-1756712

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