Water flow data from oyster reciprocal transplant experiment conducted at two sites in an estuary in NE Florida between July 2019 and April 2020

Website: https://www.bco-dmo.org/dataset/882674
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2022-10-16

Project
» Collaborative research: Quantifying the influence of nonconsumptive predator effects on prey population dynamics (Predatory NCEs and Scale)

Contributors	Affiliation	Role
Kimbro, David L.	Northeastern University	Principal Investigator
White, J. Wilson	Oregon State University (OSU)	Co-Principal Investigator
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Coverage

Spatial Extent: **N**:29.77002 **E**:-81.2144 **S**:29.62923 **W**:-81.2641
Temporal Extent: 2019-08-19 - 2020-04-02

Methods & Sampling

A reciprocal transplant experiment was conducted at two sites in an estuary in NE Florida, USA that encompassed different environmental (salinity, aerial exposure) and biotic (predators) stressors. Juvenile oysters were reciprocally transplanted within and between the two locations within the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR)--the Butler site at 29.77002 N, -81.2641 W, and the Pellicer site at 29.62923 N, -81.2144 W. At each location, the home and away oyster 'demes' were randomly assigned between a predator exclosure and a control treatment.

To obtain site-specific information of water flow, a Nortek current profiler (Aquadopp Profiler 2MHz) was placed in a PVC stand and deployed in the water in front of the oyster reefs during the monthly oyster checks. The instrument was set with a blanking distance of 0.2m. The bin sizes were set 0.1m and 15 cells. The instrument recorded every minute except for two days (9/2/2018 and 9/4/2018) when the sampling interval was set to 30 seconds. The data was offloaded using AquaPro V1.37.08 and then converted to a Profile CSV. The .csv was uploaded into R and reorganized (see Processing Description).

Data Processing Description

Data processing
The data was offloaded using AquaPro V1.37.08 and then converted to a Profile CSV. The .csv file was uploaded into R and reorganized using the R code titled "Flowmeter_Processing.R", which is accessible from the Supplemental Files section below, along with the data files used for input.

Butler site Aquadopp raw data files:

- RR.B0202.csv (time period: 2019-09-20 to 2019-11-12)
- RR.BU01.csv (time period: 2019-12-01 to 2020-01-07)
- Risk.B01.csv (time period: 2020-01-21 to 2020-01-31)
- RiskB01.csv (time period: 2020-02-08 to 2020-03-04)
- RR.301.csv (time period: 2020-03-06 to 2020-03-30)

Pellicer site Aquadopp raw data files:

- RT.Pel01.csv (time period: 2019-08-19 to 2019-08-29)
- RT.Pel03.csv (time period: 2019-10-02 to 2019-10-22)
- RT.P201.csv (time period: 2019-11-06 to 2020-02-19)
- RT.pel04.csv (time period: 2020-03-04 to 2020-04-02)

Both sites (Butler and Pellicer) have multiple raw data files because each logger deployment (time period) had specific processing steps that needed to be performed.

Readings that were underwater or included the surface of the water were used while the rest of the readings were not. This was done by adding 0.1 to the pressure sensor readings and then only including values less than the position of the cell. For example, if the pressure was 0.54m then the sort value would be 0.64. Cells with measured values of 0.5 and 0.6 would be included, but 0.7 would not.

Attitude sensor data (i.e. pitch, roll, and bearing) were used to correct for any motion or change in the instrument's position. Additional summary and statistics information can be found in the "rt_flow.csv" file, which includes the Date, Site, Speed (meters/second), and N (number of readings collected per deployment).

Problems/Issues
Aquadopp data was missing from:

- Butler: June 2019;
- Butler 3: November 2019;
- Pellicer 1: January 2020 and Febuary 2020
- Pellicer 3: January 2020 and February 2020;

Note: Pellicer 1 and Pellicer 3 are the same from September 2019 onward.

BCO-DMO Processing description:
- Converted dates to format (YYYY-MM-DD)
- Sorted by Site and DateTime
- Added columns for "Latitude" and "Longitude" based on geospatial bounds
- Added a conventional header with dataset name, PI names, version date

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Supplemental Files

File
Flowmeter processing R script filename: Flowmeter_Processing.R (Comma Separated Values (.csv), 4.06 KB) MD5:806d00fc2990aa7e34e0404593215fc2 This Flowmeter processing script stitches together data from the AquaDopp instrument and compiles information into a long format with usable depths. Written by Adrienne Breef-Pilz (26 Oct 2022) and used for David Kimbro's reciprocal transplant experiment.
Flowmeter raw data for Butler site filename: Butler_AquaDopp_flowmeter_raw.zip (ZIP Archive (ZIP), 425.90 KB) MD5:3e2a6030ce1c4436672d27312216e063 Compressed folder of AquaDopp flowmeter raw data for the Butler site. The files are inputs to the Flowmeter_Processing_R_Script and are listed here with time periods of coverage: RR.B0202.csv (time period: 2019-09-20 to 2019-11-12) RR.BU01.csv (time period: 2019-12-01 to 2020-01-07) Risk.B01.csv (time period: 2020-01-21 to 2020-01-31) RiskB01.csv (time period: 2020-02-08 to 2020-03-04) RR.301.csv (time period: 2020-03-06 to 2020-03-30) The headings are DateTime, Battery, Heading, Pitch, Roll, Pressure, Temperature, AnalogIn1, AnalogIn2, Speed, and Direction. These last two parameters are repeated as needed for sampling.
Flowmeter raw data for Pellicer site filename: Pellicer_AquaDopp_flowmeter_raw.zip (ZIP Archive (ZIP), 465.73 KB) MD5:653beccbef204ca46b7bc3977aee2c25 Compressed folder of AquaDopp flowmeter raw data for the Pellicer site. The files are inputs to the Flowmeter_Processing_R_Script and are listed here with time periods of coverage: RT.Pel01.csv (time period: 2019-08-19 to 2019-08-29) RT.Pel03.csv (time period: 2019-10-02 to 2019-10-22) RT.P201.csv (time period: 2019-11-06 to 2020-02-19) RT.pel04.csv (time period: 2020-03-04 to 2020-04-02) The headings are DateTime, Battery, Heading, Pitch, Roll, Pressure, Temperature, AnalogIn1, AnalogIn2, Speed, and Direction. These last two parameters are repeated as needed for sampling.
Summary of water flow data from reciprocal transplant experiment filename: rt_flow.csv (Comma Separated Values (.csv), 259.51 KB) MD5:afc7d3df5bc1e571eeaa2de357546120 Water flow data from reciprocal transplant oyster experiment. Current meter summary data with date, site, speed, and number of readings collected per deployment.

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Related Publications

Kimbro, D. L., White, J. W., Breef-Pilz, A., Peckham, N., Noble, A., & Chaney, C. (2022). Evidence for local adaptation of oysters to a within-estuary gradient in predation pressure weakens with ontogeny. Journal of Experimental Marine Biology and Ecology, 555, 151784. https://doi.org/10.1016/j.jembe.2022.151784
Results

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
Software

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Related Datasets

IsRelatedTo

Kimbro, D. L., White, J. (2022) **(DRAFT) Tidal inundation results from oyster reciprocal transplant experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-16 http://lod.bco-dmo.org/id/dataset/882626 [view at BCO-DMO]

Kimbro, D. L., White, J. (2022) **(DRAFT) Water salinity and temperature data from oyster reciprocal transplant experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-16 http://lod.bco-dmo.org/id/dataset/882657 [view at BCO-DMO]

Kimbro, D. L., White, J. (2022) **Individual oyster results from an oyster reciprocal transplant experiment conducted at two sites in an estuary in NE Florida between August 2019 and May 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-14 http://lod.bco-dmo.org/id/dataset/880691 [view at BCO-DMO]

Kimbro, D. L., White, J. (2022) **Predator size and abundance data from oyster reefs in a northeast Florida estuary collected between April and August 2019 as part of an oyster reciprocal transplant experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-12-13 http://lod.bco-dmo.org/id/dataset/882641 [view at BCO-DMO]

Kimbro, D. L., White, J. (2022) **Survival and growth data from an oyster reciprocal transplant experiment conducted at two sites in an estuary in northeast Florida between August 2019 and May 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-16 http://lod.bco-dmo.org/id/dataset/882606 [view at BCO-DMO]

Kimbro, D. L., White, J., Breef-Pilz, A. (2022) **Seawater properties at two locations in a northeast Florida estuary measured using HydroCAT CTD between July 2019 and April 2020 as part of an oyster reciprocal transplant experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-12-16 http://lod.bco-dmo.org/id/dataset/885452 [view at BCO-DMO]

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Nortek current profiler (Aquadopp Profiler 2MHz)
Generic Instrument Name	Nortek Aquadopp Doppler current profiler
Dataset-specific Description	To obtain site-specific information of water flow, a Nortek current profiler (Aquadopp Profiler 2MHz) was placed in a PVC stand and deployed in the water in front of the oyster reefs
Generic Instrument Description	A family of self-contained Doppler current profilers, Nortek Aquadopp Profilers are often referred to as AquaPro instruments. They are designed for deployment on the seabed, moorings, buoys or fixed structures. They can feature a range of transducers - 400 kHz (60-90m range: 2-8m cell size), 600 kHz (30-40m range: 1-4m cell size), Z-cell 600 kHz, 1 MHz (12-25m range: 0.3-4m cell size), Z-cell 1MHz, 2 MHz (4-10m range:0.1-2m cell size) and side-looking. Each transducer has 3 beams and the instrument has a maximum of 128 cells. Current speeds up to 10 m/s may be measured at an accuracy of 1% of measured value ±0.5cm/s. The standard depth rating is 300 m with 3000 m or 600m versions available. Temperature (embedded thermistor with 0.1C accuracy and 0.01C resolution), compass (magnetometer with 2 degrees accuracy and 0.1 degree resolution providing tilt

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Project Information

Collaborative research: Quantifying the influence of nonconsumptive predator effects on prey population dynamics (Predatory NCEs and Scale)

Coverage: Sub-tropical estuarine waters (29.67,-81.21)

NSF Award Abstract:
Predators can affect populations of their prey in two ways: by consuming them ("consumptive effects" or "CE"s), or by causing the prey to change behavior to avoid contact with the predator. For example, prey often spend less time feeding and more time watching out for predators, which comes with the cost of lower food intake and thus slower growth. Such "non-consumptive effects" (NCEs) have been described for a wide range of terrestrial and marine prey species, from elk to clams, but mostly in short-term (< 1 month) experiments. These prior results suggest that in some cases, the behavioral changes (NCEs) have a bigger effect on prey populations than consumption by predators (CEs). However, those short-term, controlled experiments may artificially inflate the perceived importance of NCEs. Over longer time periods, prey may adapt or become acclimated to predation risk, and NCEs may become less important. Additionally, environmental variability (e.g., differences in the availability of the prey's food between study sites) may have a bigger effect on prey populations than NCEs do. This project will use a combination of short- (months) and long-term (years) field experiments and mathematical models to evaluate the role of NCEs on Florida oyster reefs. The prey species in this study is the eastern oyster, an important marine resource in the southeast US for harvesting and habitat creation; the main oyster predator is a mud crab. In this study, results from mathematical models of oyster populations will be compared to experimental data from the field to see whether including NCEs in the model leads to better model predictions. Better understanding of NCEs in oysters should improve management of that important marine resource. Furthermore, the mathematical model will be used to develop broader, generalizable conclusions about the importance of NCEs that could be applied to other important prey species. This project will provide data useful for oyster resource management, will support public education regarding the ecological importance of NCEs, and will enhance the scientific engagement of underrepresented groups in the study region. The project will support a partnership with the Guana Tolomato Matanzas National Estuarine Research Reserve in Florida, including data sharing, sponsoring an oyster management symposium, and funding the development of multimedia scientific outreach materials at the reserve that will be used by a large and diverse population of K-12 students in the surrounding community. The project will train a postdoctoral researcher, two graduate students, two undergraduate students, and research results will be disseminated by those students and the principal investigators at scientific conferences, in journal publications, and in online content through an ongoing partnership with a Florida public television station.

Predators can alter prey population dynamics by causing fear-based shifts in prey traits (nonconsumptive effect, NCE). The importance of NCEs for prey populations - relative to direct consumption by predators (consumptive effects, CEs) - remains uncertain, particularly because short-term studies of NCEs cannot estimate their effect over multiple prey generations. This project addresses that knowledge gap by combining short- and long-term field experiments with population models to investigate the importance of NCEs on oyster population dynamics in a Florida estuary. The central question is whether accounting for NCEs improves the ability to predict long-term trends in oyster population abundance. Several types of NCEs are present in this system: exposure to water-containing predator odors reduces oyster larval recruitment and causes juvenile oysters to increase shell thickness, reducing their somatic growth. In addition to CEs and NCEs, environmental gradients in stress, food, and propagule delivery are also present in this system. Those environmental factors can have strong effects on post-settlement survivorship, growth, and recruitment of oysters, so the relative importance of predator CEs and NCEs may vary along those spatial gradients as well. This project will consist of four components. (1) A series of short-term field experiments to test how NCEs vary with predator density and environmental variables, and whether one of the NCEs (increased shell thickness) actually reduces vulnerability to predators. (2) A population model, parameterized using experimental results; model simulations will quantify how the relative importance of NCEs should vary over time, space, and environmental gradients. (3) A longer-term (3.5 year) field experiment; the results from this experiment will be compared to model predictions to test whether accounting for NCEs improves predictions of long-term variation in oyster population dynamics. (4) A general form of the model will be developed to broadly investigate the effect of NCEs on non-equilibrium, transient population dynamics. By combining models and field experiments, this project will bridge the gap between the theoretical understanding of how NCEs affect population dynamics and empirical tests of that theory, advancing the field towards the goal of predicting how multiple interacting factors structure communities.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736943
NSF Division of Ocean Sciences (NSF OCE)	OCE-1820540

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