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

Website: https://www.bco-dmo.org/dataset/882606
Data Type: Other Field Results, experimental
Version: 1
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Project
» Collaborative research: Quantifying the influence of nonconsumptive predator effects on prey population dynamics (Predatory NCEs and Scale)

Contributors	Affiliation	Role
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Abstract
Results in this data set come from an oyster reciprocal transplant experiment conducted at two sites in an estuary in NE Florida, USA. At two sites that encompassed different environmental (salinity, aerial exposure) and biotic (predators) stressors, juvenile oysters were reciprocally transplanted within and between the two locations. At each location, the home and away oyster 'demes' were also randomly assigned between a predator exclosure and control treatment. After one month and nine months, the survival of oysters was quantified.

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Coverage

Spatial Extent: **N**:29.77002 **E**:-81.2144 **S**:29.62923 **W**:-81.2641
Temporal Extent: 2019-08-17 - 2020-05-18

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. At each location, the home and away oyster 'demes' were randomly assigned between a predator exclosure and a control treatment. After one month and then again at nine months, the individual traits (shell length, shell thickness, and condition index) of the oysters were measured and destructively sampled. (Note: multiple oysters were observed for each experimental unit/cage)

Spat Collection: Oyster spat that had naturally settled out on dead oyster shells were collected from reefs in two zones of the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR). The zones were the Butler site at 29.77002 N, -81.2641 W, and the Pellicer site at 29.62923 N, -81.2144 W. Shells contained one to three spat which was marked using nail polish. Shells were attached to a 2 x 2 inch square of bird netting using 2-part marine epoxy. Dead shell/bird netting was attached to a 1 ft length of PVC using cable ties, with differing numbers of dead shells used to obtain the density of three spat per PVC length (“oyster pop”). All PVC posts were numbered. Initial sizes of all spat were recorded prior to outplant. Three spat from one of the locations (either Butler or Pellicer) were placed in each experimental unit (cage or control).

Cages: Cages were 12” X 12” X 12” made from Industrial Netting (Product Number XB1132). The bottom of the cage was open and buried into the ground. Half-inch PVC pipes 12” long were cabled tied to the inside corners of the cage to give it some stability. The control plots consisted of four PVC posts hammered into the ground 12” apart from each other. Cages were deployed in the vertical midpoint of the reef at both Butler and Pellicer zones to allow for the reciprocal transplant design.

Survival: At each location, the home and away oyster ‘demes’ were also randomly assigned between a predator exclosure and control treatment. After one month and nine months, the survival of oysters was quantified.

Each of these experimental units contained three posts that were removed one month after deployment (Sept. 2019) and three posts removed after nine months (May 2020). Those time periods correspond approximately to a post-settlement/juvenile stage (vulnerable to mud crabs), and an early adult stage (preferred by crown conch), respectively. At each sampling period, the oysters attached to the sampled post were removed, brought to the lab, and processed to quantify two fitness components: survival (live or dead) and growth (final – initial shell length).

Data Processing Description

Data Analysis:
Because individually marked oysters were scored as alive or dead, oyster survival was evaluated with a generalized linear model using a binomial error and logit link transformation. For details, see Kimbro et al. (2022)

BCO-DMO Processing description:
- Imported data from source files "rt_survival.csv" and "rt_growth.csv"
- Joined the two files together (matched rows)
- Converted dates to format (YYYY-MM-DD)
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- 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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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

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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) **Water flow data from oyster reciprocal transplant experiment conducted at two sites in an estuary in NE Florida between July 2019 and April 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-16 http://lod.bco-dmo.org/id/dataset/882674 [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

Parameter	Description	Units
latitude	Latitude of reef location for experiment	decimal degrees
longitude	Longitude of reef location for experiment	decimal degrees
meter	Placement of the experimental plot along the transect	meter (m)
post	Unique post number to identify the shells (1 to 20)	unitless
treatment	Experimental treatment of the plot (cage or control)	unitless
reef	Name of the reef where experiment was completed (Butler or Pellicer)	unitless
spat_source	Name of the reef from which the spat originated (Butler or Pellicer)	unitless
home_or_away	Indicator for whether the spat source in experiment was at reef of origin; home=spat source and reef are the same; away=spat source and reef are different.	unitless

position	Placement of post in cage from left to right, and also the order for harvesting (1, 2, or 3)	unitless
date_checked	Date when spat were measured	unitless
month_checked	Month since the experiment began (initial, one, three, nine)	unitless
number_shells	Number of shells attached to a post. This is the number of dead adult oyster valves which contained naturally settled, living juvenile oysters.	unitless
color	Color of the spat used for identification over time (red, blue, or purple)	unitless
status	Status of the spat; 0=dead, 1=alive, 2=missing	unitless
size	Length of the shell	millimters (mm)
diff	Difference in length between the initial size (month 0) and size at the time of sampling	millimters (mm)
missing_cage	Flag indicating whether cage was missing	unitless
notes	Notes on the oyster taken during sampling and measurements	unitless

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Instruments

Dataset-specific Instrument Name	Mettler Toledo NewClassic MS
Generic Instrument Name	scale or balance
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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