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

Website: https://www.bco-dmo.org/dataset/880691
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2022-10-14

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
These data come from an 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 individual traits (shell length, shell thickness, and condition index) of oysters (multiple oysters observed for each experimental unit) were destructively sampled.

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Coverage

Spatial Extent: **N**:29.77 **E**:-81.2144 **S**:29.6292 **W**:-81.2641
Temporal Extent: 2019-08 - 2020-05

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 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 containing living, juvenile oysters were selected, and the spat (1 to 3) were marked using fingernail polish (red, blue, purple). Initial sizes (length from umbo to tip) of all spat were recorded prior to outplant.

The shells containing the living juvenile oysters were attached to a 2 x 2 inch square of bird netting using 2-part marine epoxy. These dead shell and bird netting combinations were attached to a 1 ft length of PVC using cable ties threaded through the mesh to obtain the density of three spat per PVC length ("oyster pop"). All PVC posts were marked with unique numeric identifiers, and each held three oysters from a single deme.

Cages: Three spat from one of the locations (either Butler or Pellicer) were placed in each experimental unit (cage or control). 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.

Growth measurements: Each of these experimental units contained 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).

Oysters were destructively sampled at two time points to determine growth and survival. One out of three oysters was selected for initial processing and crushing. One of three oysters were frozen in plastic bags in a standard freezer (-18 degrees C) for further processing (***reciprocal_transplant_individual_metadata)***, and one of three were initially processed and set aside.

In the lab, oysters were removed from the freezer and allowed to thaw on the countertop. Thawed oysters were measured for total height and width, then shucked. The top valve (shell) and oyster tissue were placed in weighing tins. Wet weights of both were obtained using a Mettler Toledo NewClassic MS balance. Length, width, and thickness of the top valve were measured with digital calipers (Rexbeti 0-1" digital micrometer). Oyster tissue and top valve were placed in a drying oven at 60 degrees C for 72 hours (at which point they were fully dry), and then dry weights of both were recorded.

Each trait (mass, tissue mass, and shell thickness) was standardized by dividing by oyster length; hence standardized shell thickness is dimensionless.

Data Processing Description

BCO-DMO Processing description:
- 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
- Rounded columns: std_thick, std_wt, std_tissue to 3 decimal places (or to the thousandth place)

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Data Files

File
rt_traits.csv(Comma Separated Values (.csv), 19.42 KB) MD5:00d736c9167d91a2c90b2f2e8394aca7 Primary data file for dataset ID 880691

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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) **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. (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
process_date	date on which the samples were processed in the lab. Dry weights were obtained 3 days after this date	unitless
sample_date	date the sample was collected in Florida, USA	unitless
site	site within the estuary where sample was collected	unitless

latitude	latitude of sample collection	decimal degrees
longitude	longitude of sample collection (West is negative)	decimal degrees
meter	meter mark at which the sample was collected	meters (m)
treatment	the levels of the predator exclosure factor to which replicates were assigned. This includes "control" (no cage) and "cage" (predator exclosure cage)	unitless
reef	the location to which all replicates were randomly assigned and outplanted (either 'butler' or 'pellicer')	unitless
spat_source	the deme or location of origin from which oysters were collected (either 'butler' or 'pellicer')	unitless
month_checked	the month number (since deployment) that data were collected, with zero meaning deployment date, "one" being one month after deployment, and "three" as well as "nine" being three and 9 months after deployment.	unitless
oyster_ID	an identifier given to each sample, with multiple samples coming from each unique combination of treatment, spat.source, and reef. (p = purple, r = red, b = blue)	unitless
oyster_length	total length of the whole oyster	millimeters (mm)
oyster_width	total width of the whole oyster	millimeters (mm)
tissue_tin_no	unique identifier for material used to contain each sample in drying oven	unitless
tissue_tin_wt	the weight of the container in "tissue_tin_no" column	grams (g)
tissue_pre_wet	wet weight of oyster tissue mass + "tissue_tin_no" column	grams (g)
tissue_wet_wt	the weight of just the tissue (the weight of the drying tin is subtracted)	grams (g)
tissue_pre_dry	weight of oyster dry tissue mass + tin wt (column "tissue_tin_wt") after drying at 60C for 72 hours	grams (g)
tissue_dry_wt	weight of oyster dry tissue (column "tissue_pre_dry" - column "tissue_tin_wt")	grams (g)
shell_tin_no	unique identifer for tin container used for weighing shell sample	unitless
shell_tin_wt	the mass of tin container	grams (g)
shell_pre_wet	mass of shell + tin (column "shell_tin_wt")	grams (g)
shell_wet_wt	mass of wet shell before drying	grams (g)
shell_pre_dry	mass of shell dried + tin (column "shell_tin_wt") after drying at 60C for 72 hours	grams (g)
shell_dry_wt	mass of dried shell (column "shell_pre_dry" - column "shell_tin_wt")	grams (g)
shell_length	shell length of top valve of the oyster shell	millimeters (mm)
shell_width	width of the top valve of the oyster shell	millimeters (mm)
shell_thickness	thickness of top oyster valve	millimeters (mm)
std_thick	thickness of the shell divided by shell length (= units cancel)	millimeters (mm)
std_wt	mass of dried shell ("shell_dry_wt") divided by shell length ("shell_length")	grams per millimeter
std_tissue	"tissue_dry_wt" divided by "shell_length"	grams per millimeter

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Instruments

Dataset-specific Instrument Name	Rexbeti 0–1” Digital Micrometer
Generic Instrument Name	calipers
Dataset-specific Description	Length, width, and thickness of the top valve were measured with digital calipers (Rexbeti 0-1" digital micrometer).
Generic Instrument Description	A caliper (or "pair of calipers") is a device used to measure the distance between two opposite sides of an object. Many types of calipers permit reading out a measurement on a ruled scale, a dial, or a digital display.

Dataset-specific Instrument Name	ThermoScientific Heratherm OMS 180
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Dataset-specific Instrument Name	Mettler Toledo NewClassic MS
Generic Instrument Name	scale
Generic Instrument Description	An instrument used to measure weight or mass.

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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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