Non-oyster species counts and sizes from caged and non-caged juvenile oyster experiment using two cohorts from Apalachicola Bay and Ocholckonee Bay stock

Website: https://www.bco-dmo.org/dataset/821771
Data Type: experimental
Version: 1
Version Date: 2020-07-29

Project
» Collaborative Research: RAPID: Quantifying mechanisms by which Hurricane Michael facilitates a stable-state reversal on oyster reefs (Oyster Reef Reversal)

Contributors	Affiliation	Role
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Abstract
Non-oyster species counts and sizes from caged and non-caged juvenile oyster experiment using two cohorts from Apalachicola Bay and Ocholckonee Bay stock. Experiments took place from 2013 to 2016 and in 2019.

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Coverage

Spatial Extent: **N**:29.97037 **E**:-84.33401 **S**:29.6718 **W**:-85.18216
Temporal Extent: 2013-07-12 - 2019-12-06

Dataset Description

Non-oyster species counts and sizes from caged and non-caged juvenile oyster experiment using two cohorts from Apalachicola Bay and Ocholckonee Bay stock. Experiments took place from 2013 to 2016 and in 2019.

Methods & Sampling

Site Selection- From Hanley et. al 2019, this was a multi-step process that first involved using ArcGIS to partition the bay's oyster reefs (commercial and non-commercial) into six zones. Zone assignment was based on the reef's relative distance by water from the river input (near, mid, far) as well as a reef's east-west orientation to the river (East Apalachicola and West Apalachicola). Next, we randomly selected three reefs out of all possible reefs (including the experimental reefs) within each zone.

Juvenile Experiment 2013-2016: Juvenile oysters were produced from parental broodstocks at a hatchery in Jupiter, Florida (Research Aquaculture, Inc.). To establish each cohort, we collected 25 adult oysters (shell length >75 mm) from 3–5 reefs of each estuary in July 2014 and shipped them to Research Aquaculture, Inc. At the hatchery, adult oysters and their offspring were held under identical conditions in separate flow-through seawater systems to prevent cross contamination between the two bays. The broodstock from each site was manually spawned on the same day. The larvae were held until they settled (~3 weeks) and then moved to a nursery facility at the hatchery under flow-through seawater conditions with standard food concentrations. In August 2014, the two cohorts were transferred to a common flow-through facility at the Florida State University Coastal and Marine Lab. These individuals were reared in a common environment and represented juvenile oyster cohorts of the same age that had experienced identical conditions. Each experimental unit consisted of juvenile oysters (mean shell length 8 mm) that were attached to a ceramic tile (13 cm × 13 cm) using a marine epoxy, and these tiles were affixed to concrete pavers in a vertical position. Tiles of initial densities of 3 or 12 juvenile oysters in 2013 and in 2014 and 2015, 2, 6, and 10 juvenile oysters, respectively. Juvenile oyster tiles were attached to the three unoccupied posts (experimental units) and then randomly assigned among the experimental treatments of cage, cage-control, and control treatment. When each experiment ended, the control and cage-control were removed, but the cage treatment was left on the reefs to continue to generate data on oyster growth through larger adult sizes.

Juvenile Experiment 2019: Juvenile oysters were collected from Easthole(#12) (29.6803, -84.8696). The oysters had settled on to pieces of rock rubble at the site. We separated the rubble into three piles: 1 spat, 2 spat or 3+ spat. We attached the rubble to bird netting using marine epoxy and then attached them to caging material (Industrial Netting). The treatments consisted of a full cage (10”X10”X10”), a cage control: a cage with one panel missing, and a control: a (10” X 10”) panel. The number of ruble pieces inside each treatment varied between 3-5 pieces for a low density, medium density and high-density treatment. Each treatment was attached to a crab trap which had been modified so all the openings were covered with Industrial Netting so fish or other organisms would not get trapped inside. The treatments were cable tied to the outside of the crab trap. Each trap was made up of one of each treatment with the same density of rubble. In each of the three zones in the bay (ABE1, ABE2 and ABE3) we deployed 5 traps along a 15m rope. A week later we came to count the number of surviving oysters. We repeated this again in September 2019 and December 2019.

Data Processing Description

BCO-DMO Processing Notes:
- data submitted in Excel file "Apalachicola_Data_2013-2019_ABP_4.xlsx" sheet "Juv.Expt.Species" extracted to csv
- modified parameter names to conform with BCO-DMO naming conventions
- re-formatted 'deploy_date' and 'check_date' from m/d/yyyy to yyyy-mm-dd
- changed commas in the notes column to semicolons
- corrected various spellings of ochlockonee and apalachicola
- re-ordered columns
- joined juvenile species counts with species code table
- sorted columns: {reef_type}{estuary}{region}{distance}{deploy_date}{combined_round}

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Data Files

File
juv_expt_species.csv (Comma Separated Values (.csv), 422.45 KB) MD5:0574dd8da1c22c9709eb281a608e1718 Primary data file for dataset ID 821771

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Supplemental Files

File
Habitat and species codes filename: Habitat_and_species_codes.pdf (Portable Document Format (.pdf), 449.38 KB) MD5:32e5977b815e148aa3802f613ee68cbb Habitat and species codes used in the project

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Related Publications

Hanley, T., White, J., Stallings, C., & Kimbro, D. (2019). Environmental gradients shape the combined effects of multiple parasites on oyster hosts in the northern Gulf of Mexico. Marine Ecology Progress Series, 612, 111–125. doi:10.3354/meps12849
Methods

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Parameters

Parameter	Description	Units
reef_type	subtidal or intertidal	unitless
estuary	apalachicola or ochlockonee	unitless
region	east or west	unitless
distance	distance from the river: zone 1 or 2 or 3. 1 is the closest and 3 is the furthest from freshwater input	unitless
deploy_date	date the experiment was deployed	unitless
round	original experiment round number	unitless
round_subround	original experiment round number plus the time within the round (so round 1 time 2 becomes 1.2)	unitless
combined_round	round.subround plus an identifier (AJ = Apalachicola Juvenile Experiment; OJ = Ochlockonee Juvenile Experiment; AP=Apalachicola Pedator Experiment)	unitless
check_date	date the experiment was checked	unitless
visits	the number of times the experiment was checked	unitless
weeks	the number of weeks since the experiment was deployed	unitless
field_site	named field site within region	unitless
reef	specific reef within the field site	unitless
reef_name	name of reef	unitless
treatment	cage; cage control; or control	unitless
id_meter	each treatment (cage or cage control or control) was assigned a unique id. In 2019 this was the distance in meters where the treatment was placed.	unitless
taxon_info	desription of site; a competitor; a predator; or other	unitless
Classification	broad taxnomic group	unitless
Common_name	common name	unitless
Scientific_name	scientific name	unitless
species_code	species code	unitless
count	number of individuals present	each
size_mm	size of the individual	millimeters
density	when there were too many density was estimated: low/medium/high	unitless
notes	notes and comments	unitless

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Instruments

Dataset-specific Instrument Name	YSI
Generic Instrument Name	Water Quality Multiprobe
Dataset-specific Description	Used a YSI probe to get dissolved oxygen, temperature, salinity and pH at the surface and at the bottom.
Generic Instrument Description	An instrument which measures multiple water quality parameters based on the sensor configuration.

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Project Information

Collaborative Research: RAPID: Quantifying mechanisms by which Hurricane Michael facilitates a stable-state reversal on oyster reefs (Oyster Reef Reversal)

Coverage: Sub-tropic estuarine waters, subtidal and intertidal in Apalachicola Bay and Ocholckonee Bay

NSF Award Abstract:

Ecosystems can exhibit "tipping points" whereby an environmental disturbance pushes an ecosystem into an altered state from which it does not recover, even when the environment normalizes. This may have happened to valuable oyster reefs in Northwest Florida in 2012, when drought and low river flow allowed predators of oysters to flourish and consume nearly all the oysters. Despite subsequent years of normal rainfall and river flow, oysters have not recovered, suggesting the ecosystem may have crossed a tipping point. However, the timing and magnitude of the disturbance from Hurricane Michael (2018) may have pushed the ecosystem back towards its original, healthy state. In this project, investigators make field observations to gauge how predators and oysters are responding to Hurricane Michael and conduct lab experiments to test how predators and oysters respond to hurricane rainfall conditions. Additionally, they use mathematical models to predict whether effects observed in the field and lab could lead to a shift back past the tipping point. This is a rare opportunity to study how oyster ecosystems can shift back from altered to healthy states. However, a rapid response is essential before seasonal changes in the weather and bay obscure hurricane impacts. This research has several broader impacts. First, it will expand the ecological theory of tipping points. Second, it can support the management of the Apalachicola Bay oyster fishery, such as insight into the likely success of restoration efforts. The team coordinates with the Apalachicola National Estuarine Research Reserve to this end. Finally, research outputs are incorporated into ongoing public education and training efforts.

Ecosystems can rapidly shift from their original, high-value state to a new, degraded one. Such shifts have been observed in many ecosystems, but it is sometimes difficult to identify the mechanisms that mediate the shift beyond a "tipping point" and - to a greater extent - those that could mediate a shift back to the original state. Improving our understanding and predictive capability of tipping points depends on identifying the mechanisms that underlie bi-directional system shifts. In 2012, the oyster reefs of Apalachicola Bay, FL abruptly shifted into an oyster-less state when prolonged drought and low river flow allowed marine oyster predators to flourish. Despite subsequent years of normal rainfall and flow, there has not been a return shift, suggesting this ecosystem may have entered an alternate stable state. The hypothesis of this work is that in 2018 Hurricane Michael provided a sufficient disturbance to shift the system back into the attracting basin for its original state (prior observations support this prediction). This project couples field observations and lab experiments with population modeling to test whether and how Hurricane Michael initiated a reversal shift. A rapid response is essential before seasonal variability in this ecosystem obscures hurricane effects. The proposal's intellectual merit is based on its ability to address a central goal in ecology: identifying and predicting ecosystem tipping points. Combining empirical observations and models is a promising approach to advance this goal, but has not been widely applied in the field, mainly because researchers are not in place at the time of a shift. Hurricane Michael provides a unique opportunity to address this knowledge gap.

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-1917015

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