

Experimental evidence for local
adaptation of oysters to
environmental stress but not
predation pressure in the GTM
NERR

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Oyster Reefs are Important...

So We Restore Them

Economical



<https://www.delmarvanow.com/videos/life/2014/05/04/8696975/>

Ecological



https://www.disl.org/assets/uploads/education/teacher/Conf-seminar/TNC_Building_an_Oyster_Reef_2-5.pdf



<https://www.nature.org/en-us/about-us/where-we-work/priority-landscapes/gulf-of-mexico/stories-in-the-gulf-of-mexico/what-we-do-in-the-gulf-of-mexico/>

Environmental



<https://oysterrecovery.org/blog/oyster-filtration-video/>



Credit Pamela D'Angelo/2017

Evidence for Genetic by Environmental Effects on Juvenile Oysters



<http://www.josefinesprenger.com/human-values/financial/just-adapt/attachment/adapt-smaller-copy2/>

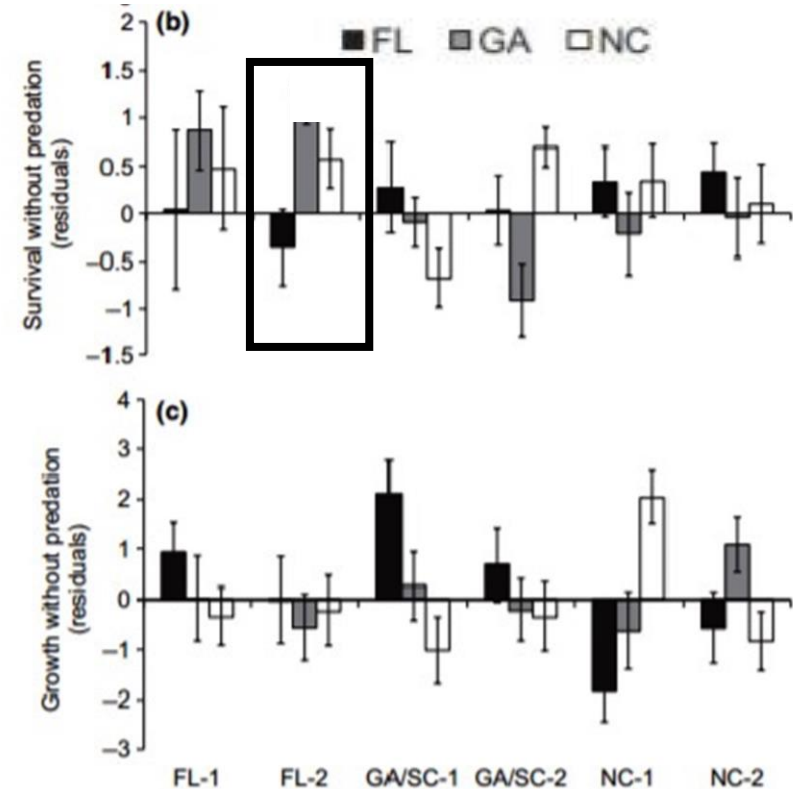


FIGURE 3 Mean (\pm SE) oyster survival and growth for six oyster cohorts at the FL (black bars), GA (gray bars), and NC (white bars) experimental sites. (A) Survival in partial cage treatments; (B) survival in cage treatments; (C) growth in cage treatments. The residuals of survival after accounting for initial oyster size and the residuals of growth after accounting for initial oyster size and the number of surviving oysters are presented

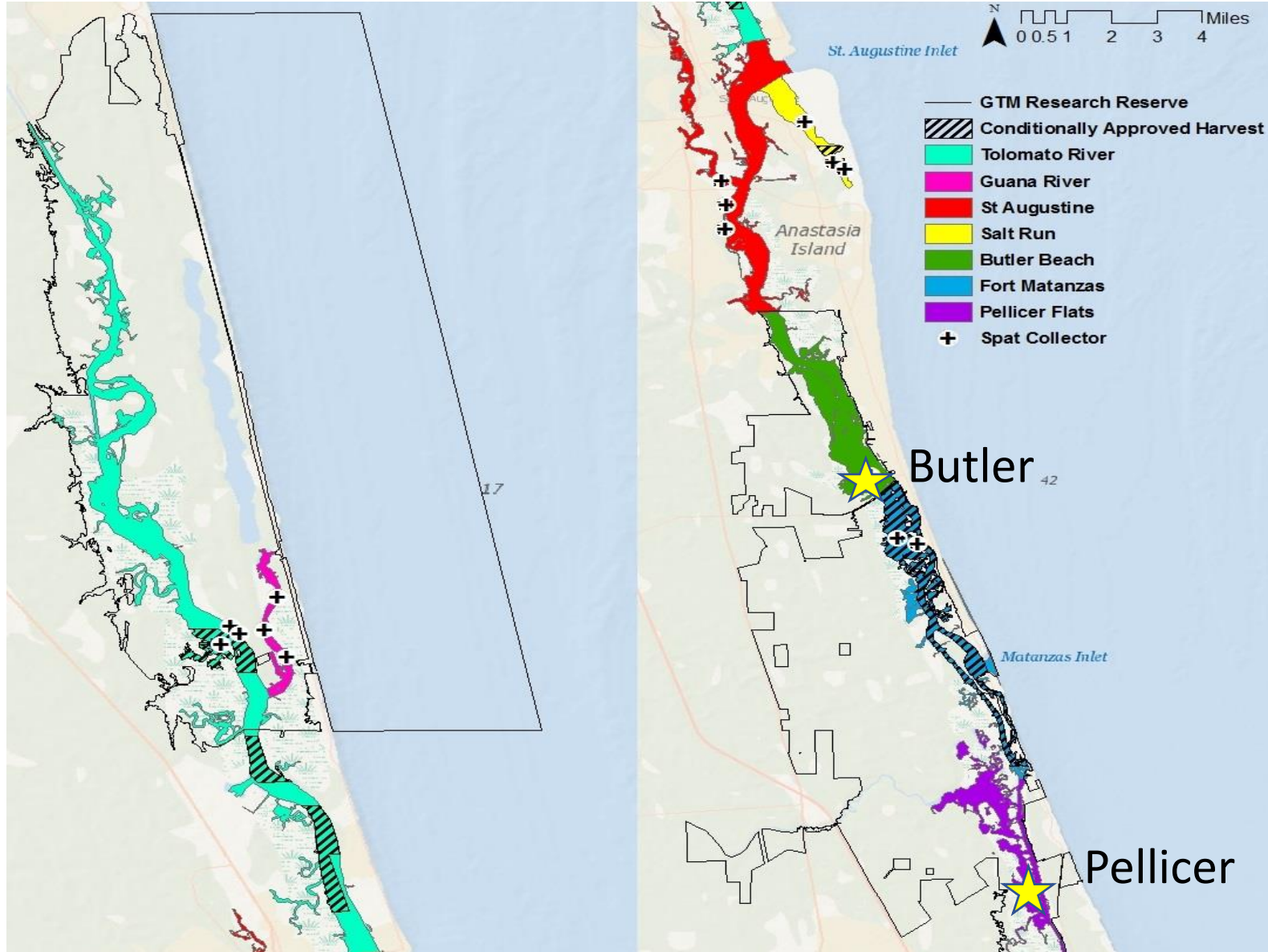
A photograph showing a vast field of oyster shells in the foreground, extending towards a line of tall grasses. In the background, a body of water and a distant shoreline with trees are visible under a clear sky. The scene is brightly lit, suggesting a sunny day.

Question

How does oyster larval dispersal and environmental gradients favor or inhibit local adaptation of oysters?

GTM Reserve

North



South

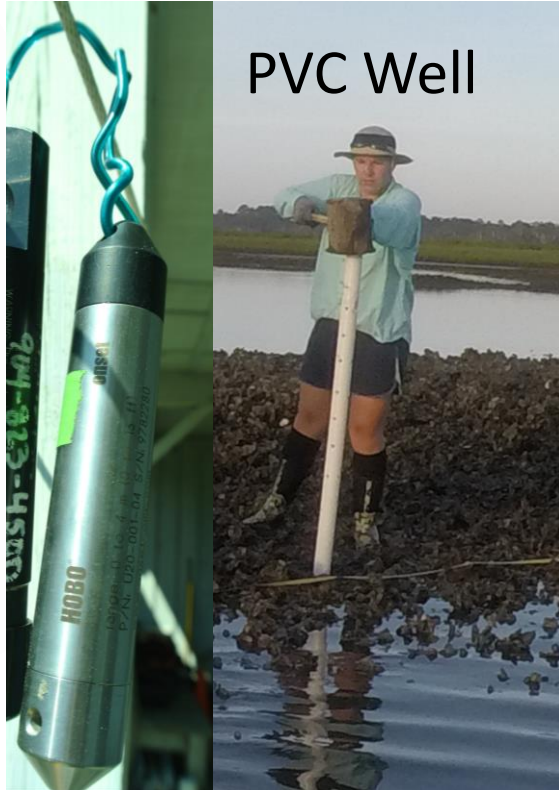
Establishing Gradients

HydroCAT CTD



By Seabird

Tidal Height Loggers



Hobo Loggers by Onset

Acoustic Doppler Current Profiler



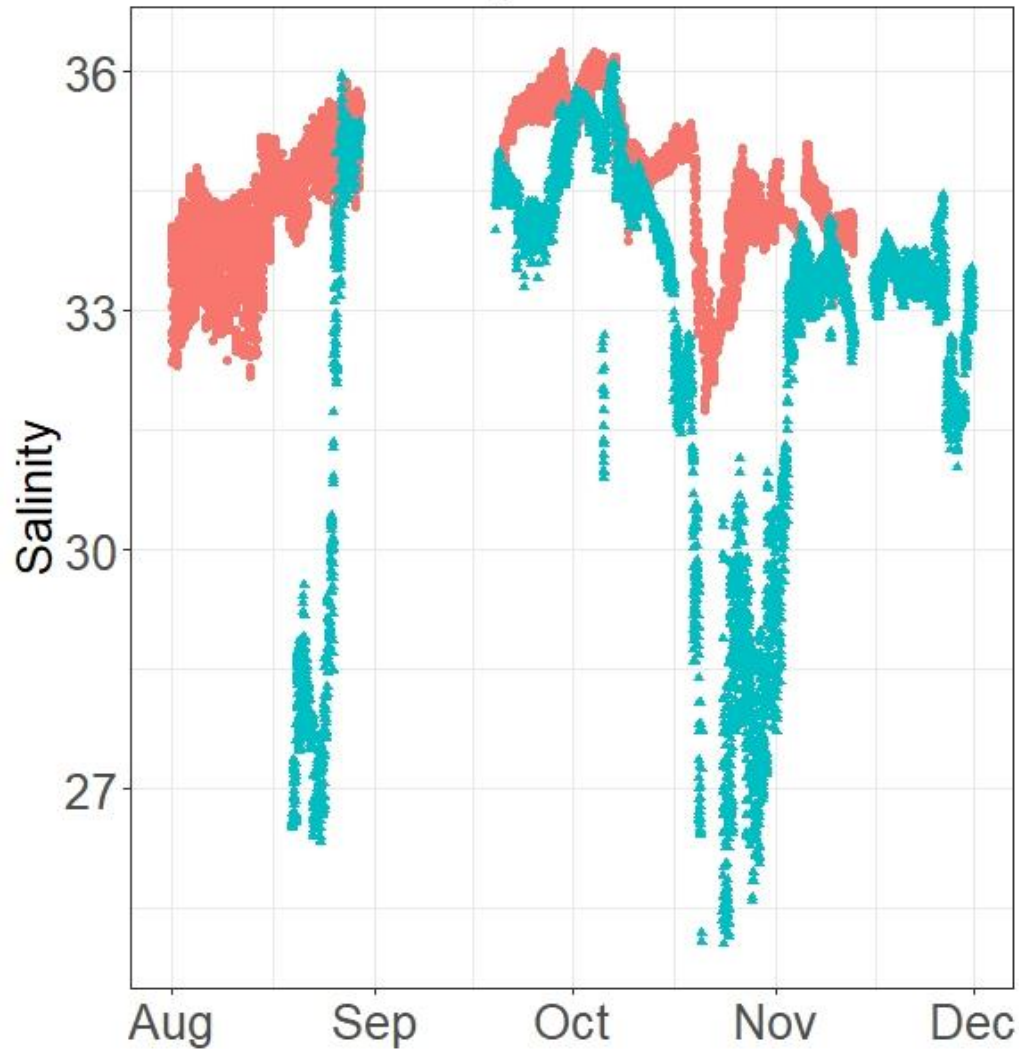
Aquadopp Profiler 2 MHz
by Nortek

Predator Surveys

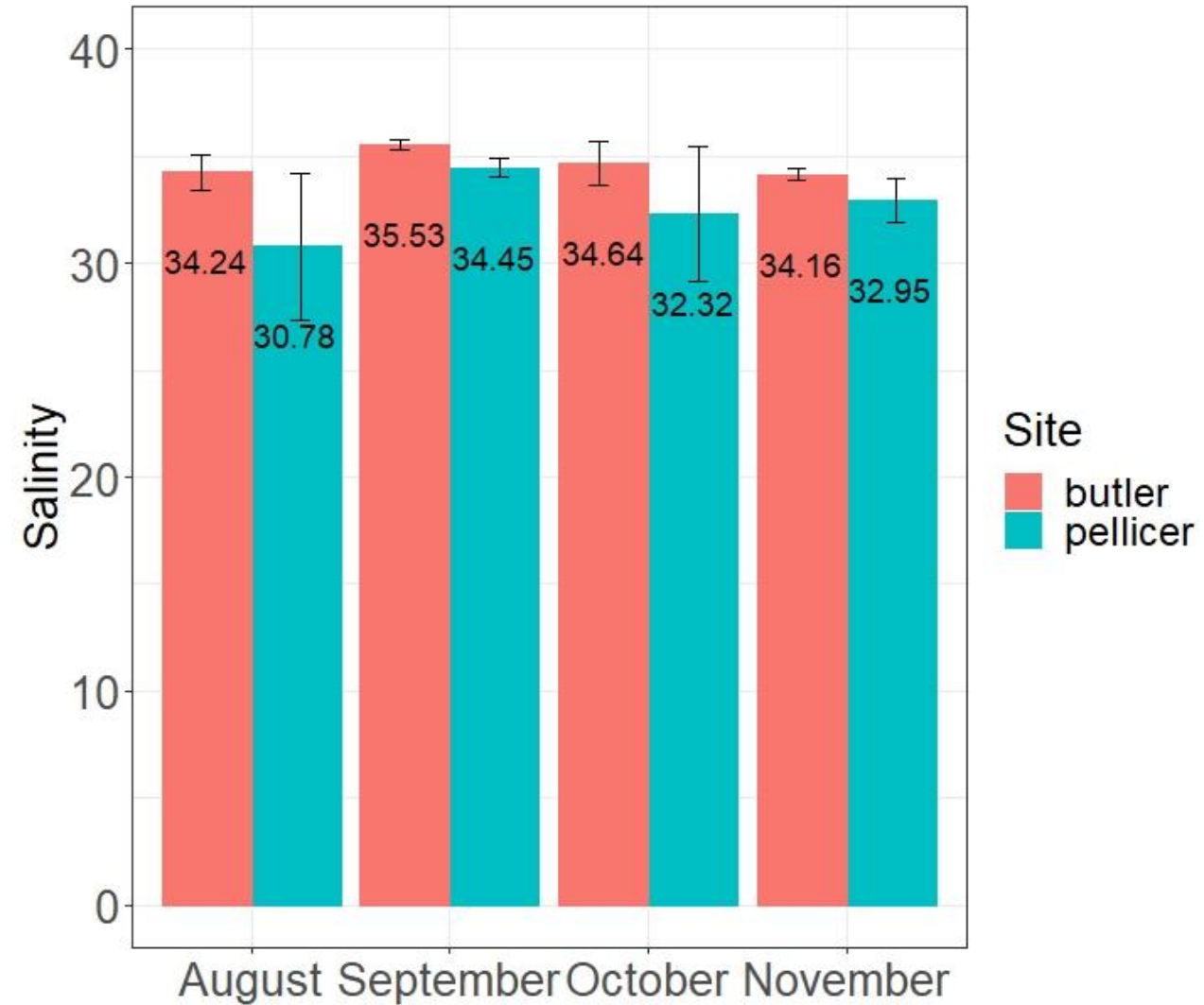


On the reef: Mudcrabs, stone crabs, and crown conch
In the water:
Blue crabs and fish

Salinity

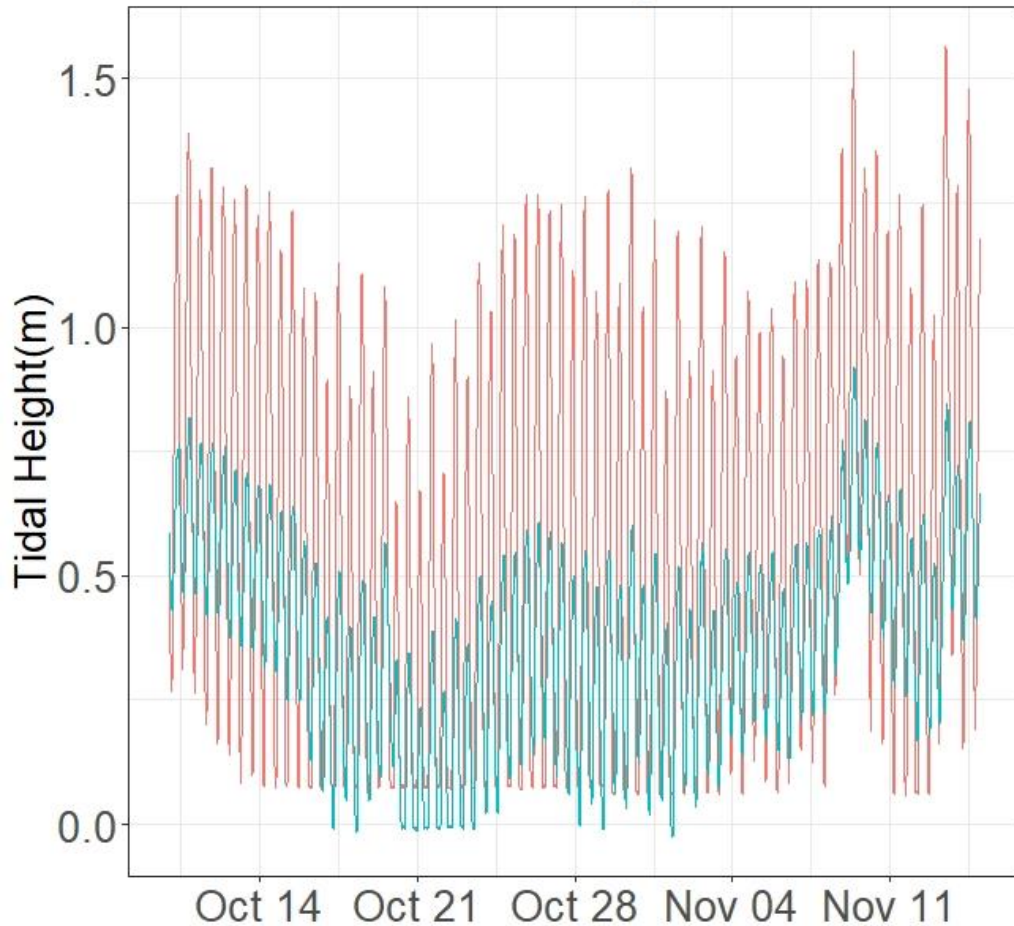


Monthly Average

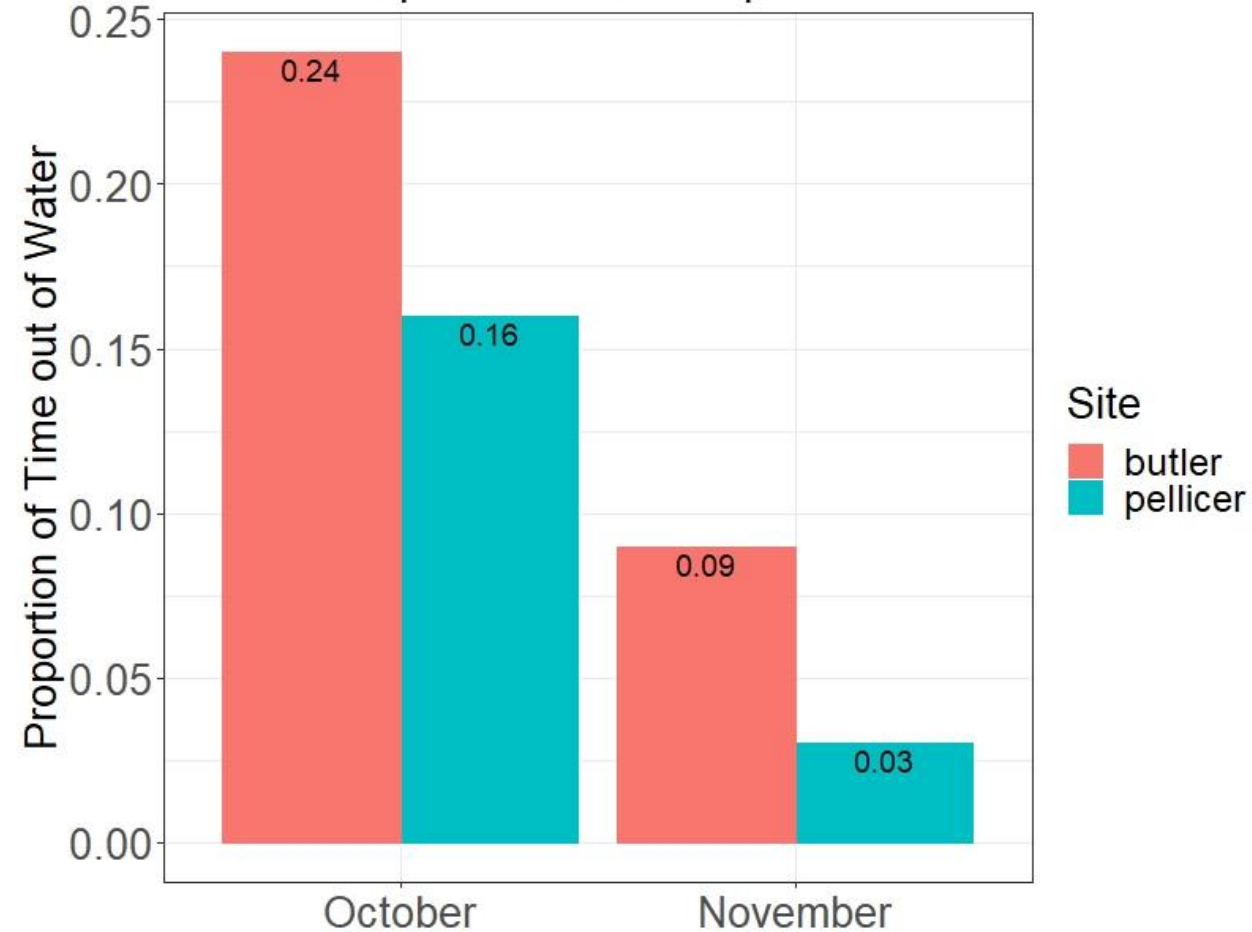


Tidal Height and Time Exposed

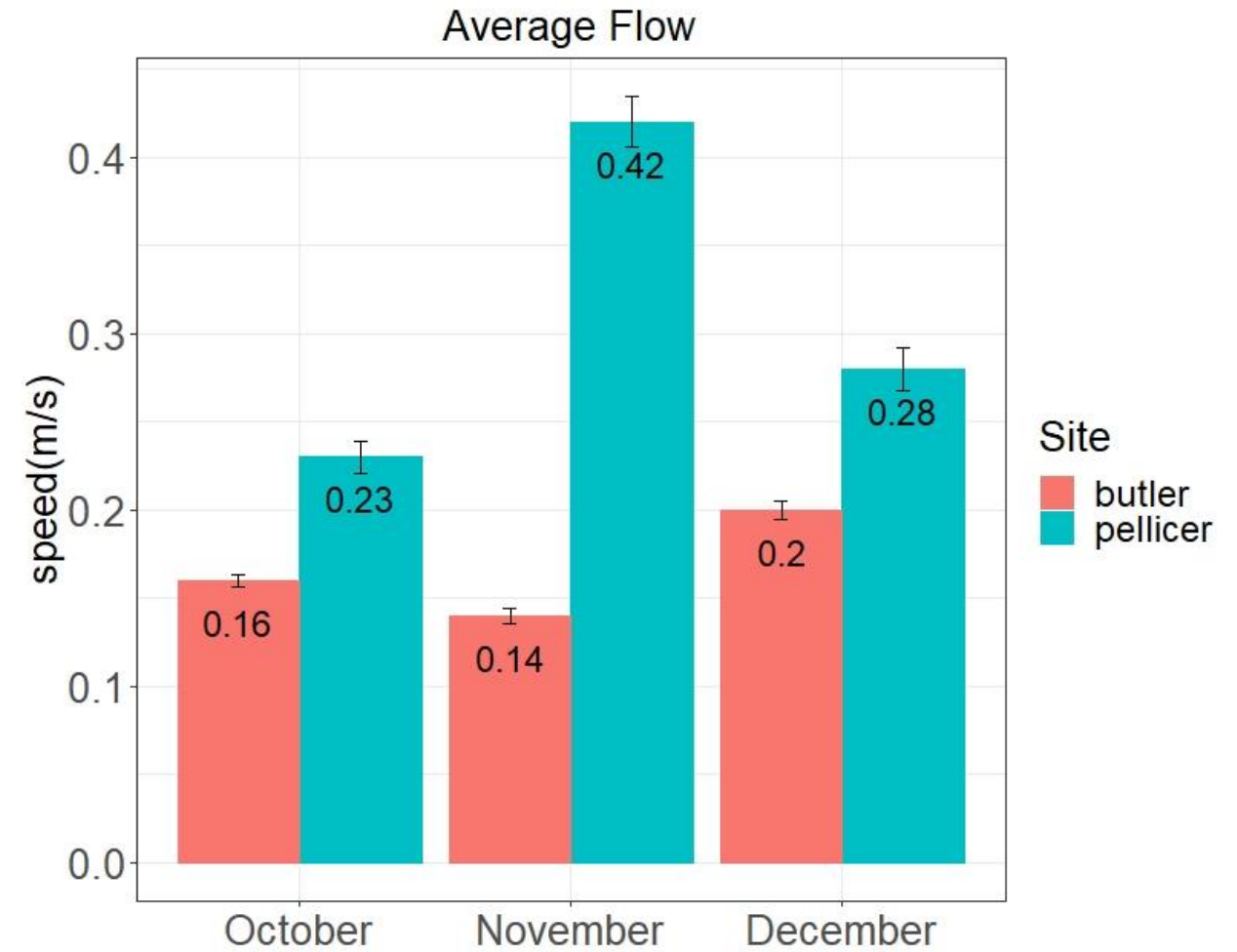
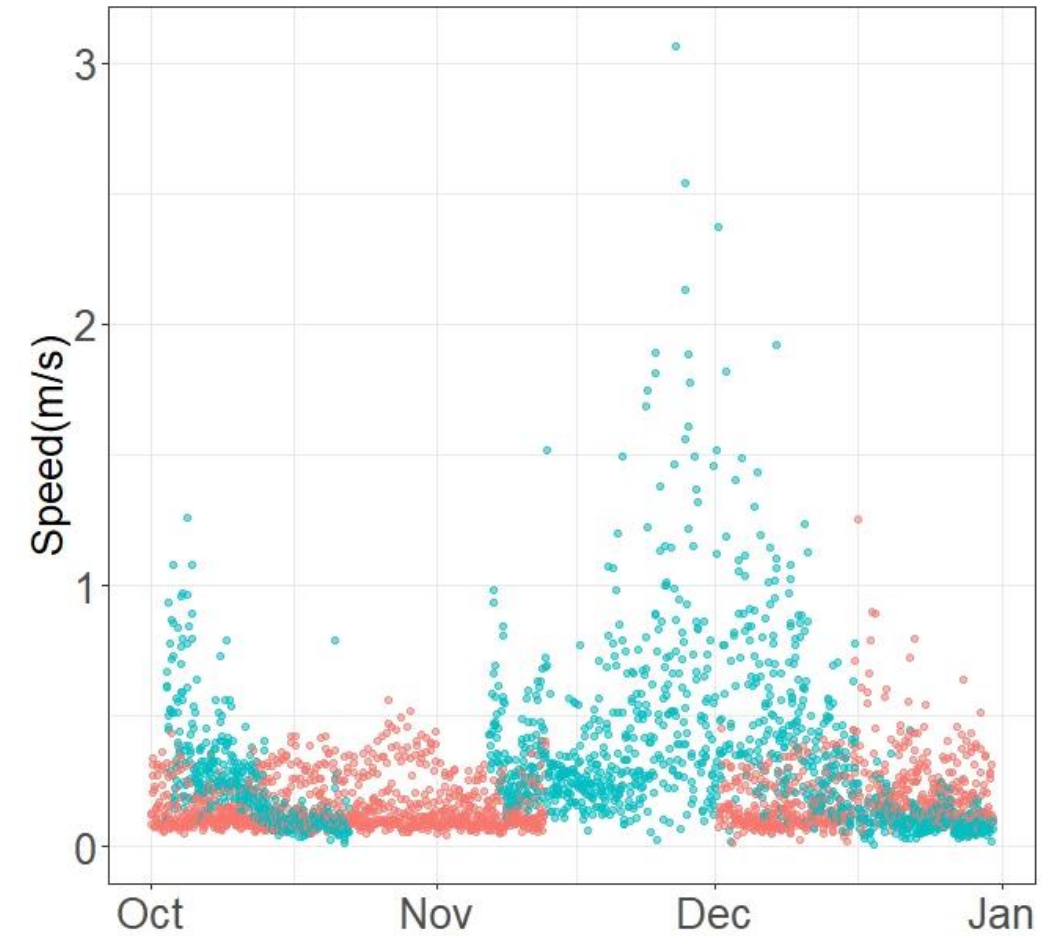
Tidal Height



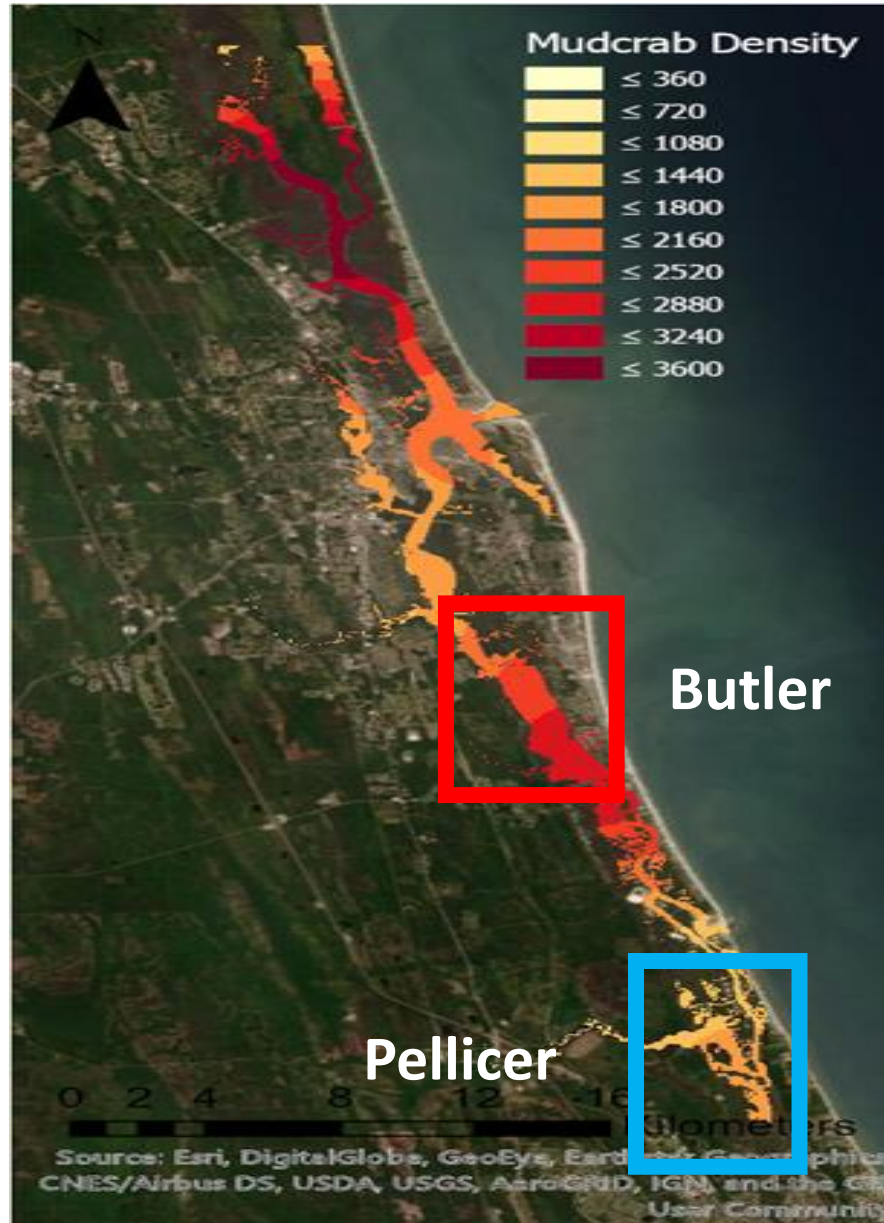
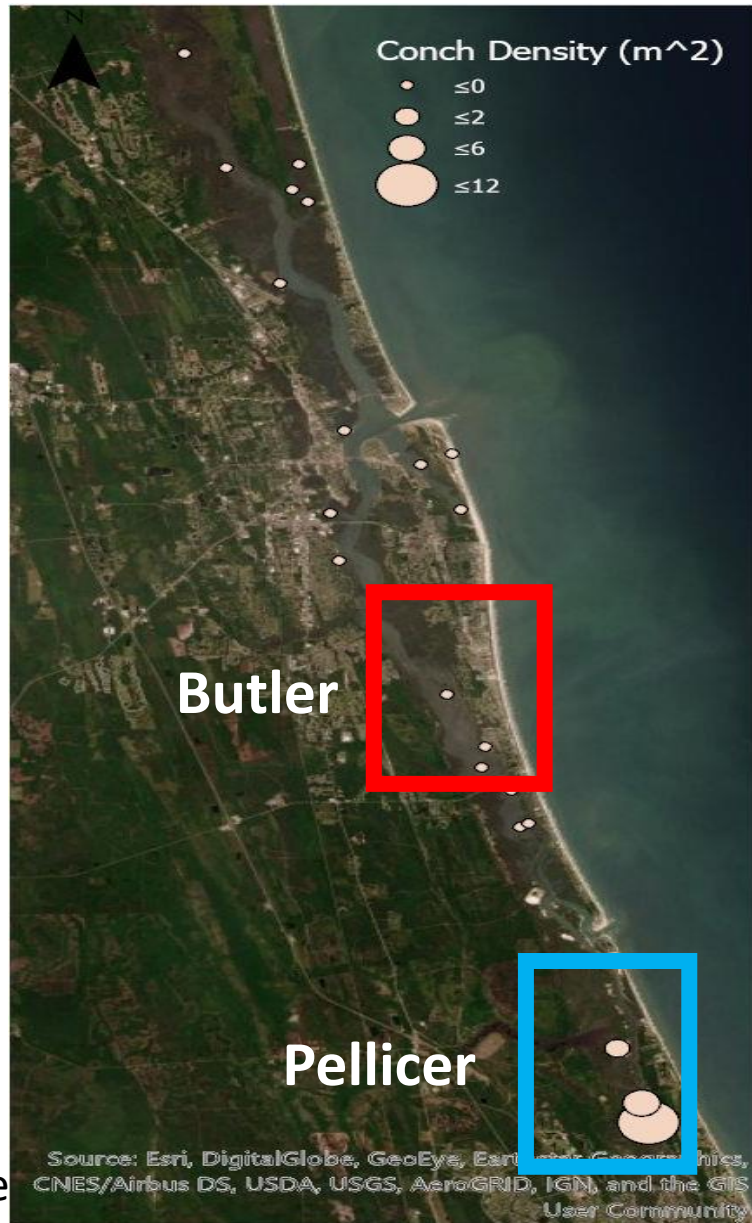
Proportion of Time Exposed



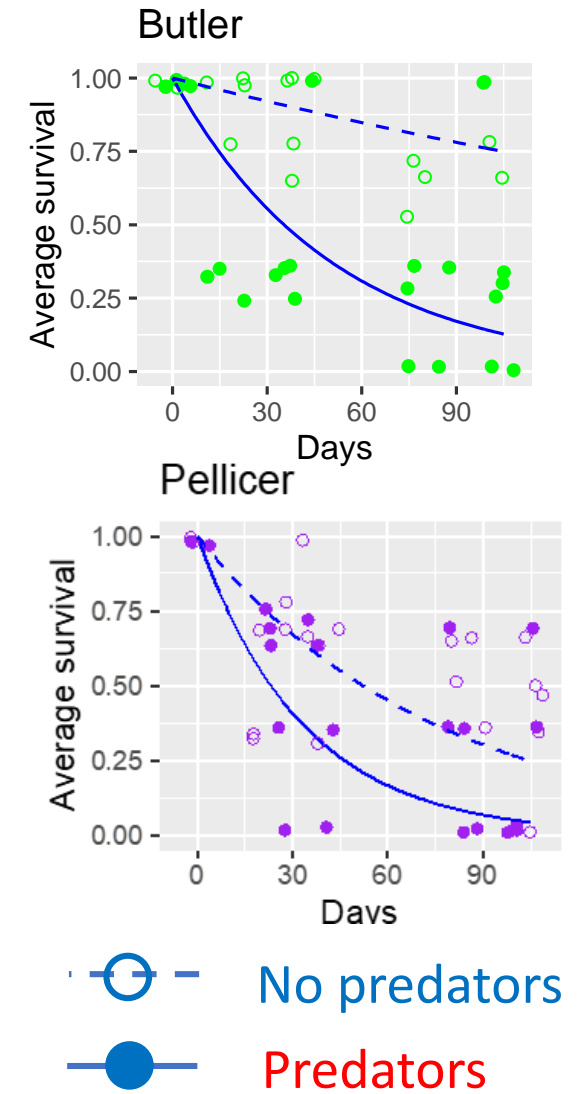
Flow



Predators Densities



Predation differs among sites (up to 100 d)

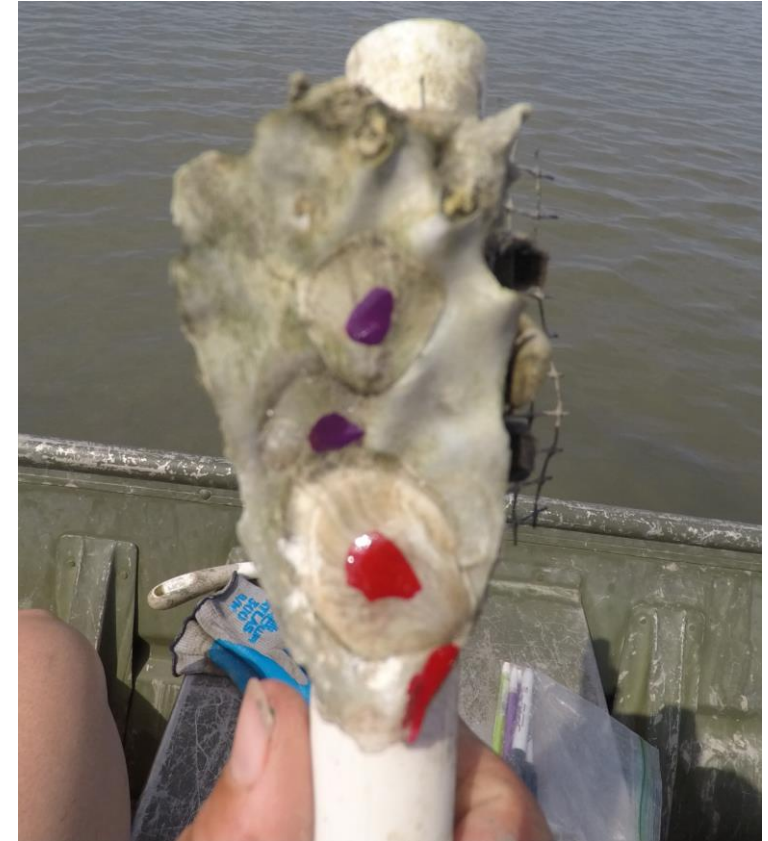


Experimental Design

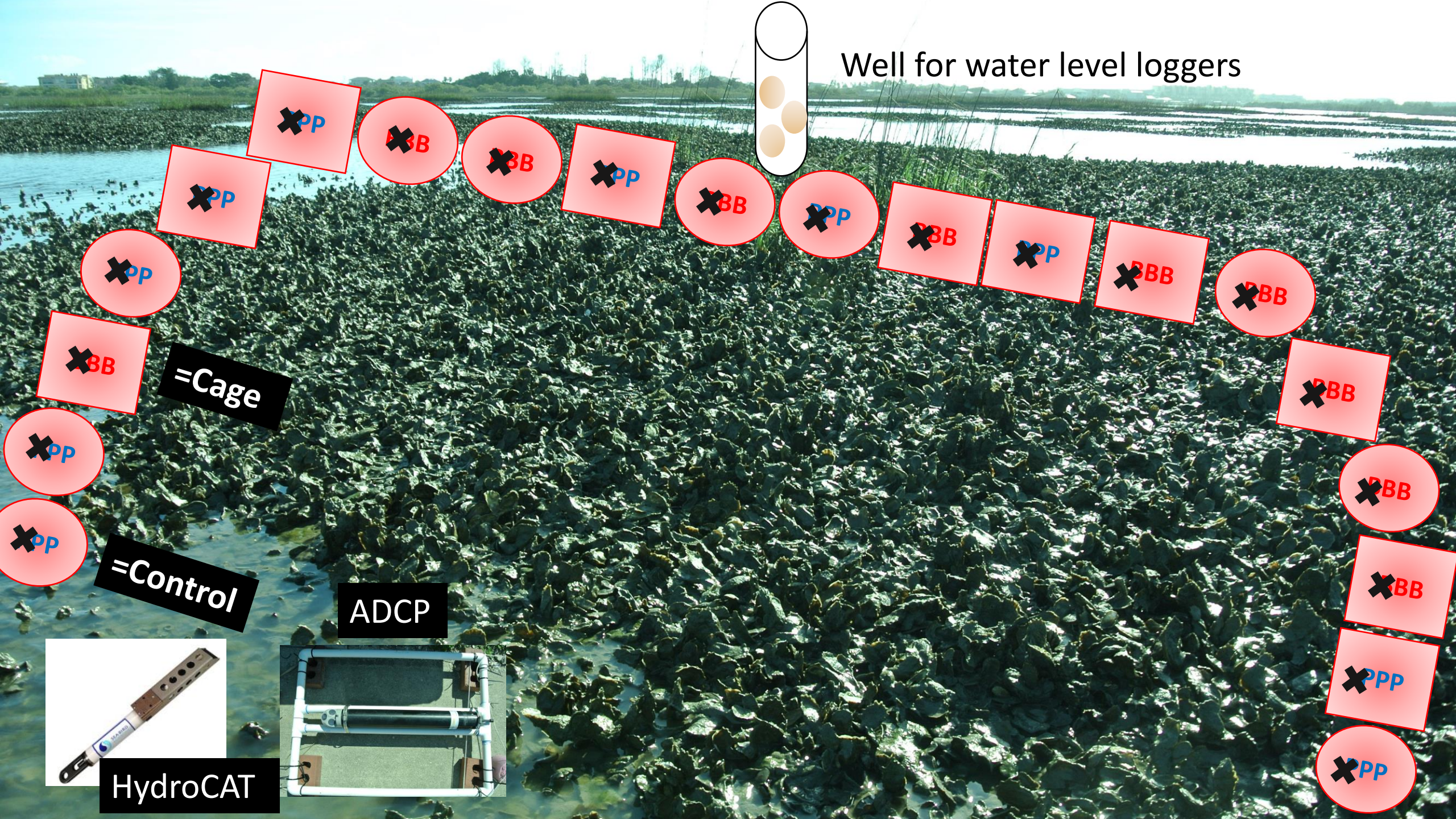
1. Find spat from Butler and Pellicer



2. Attach the shells to PVC and mark the spat



Well for water level loggers



=Cage

=Control

ADCP

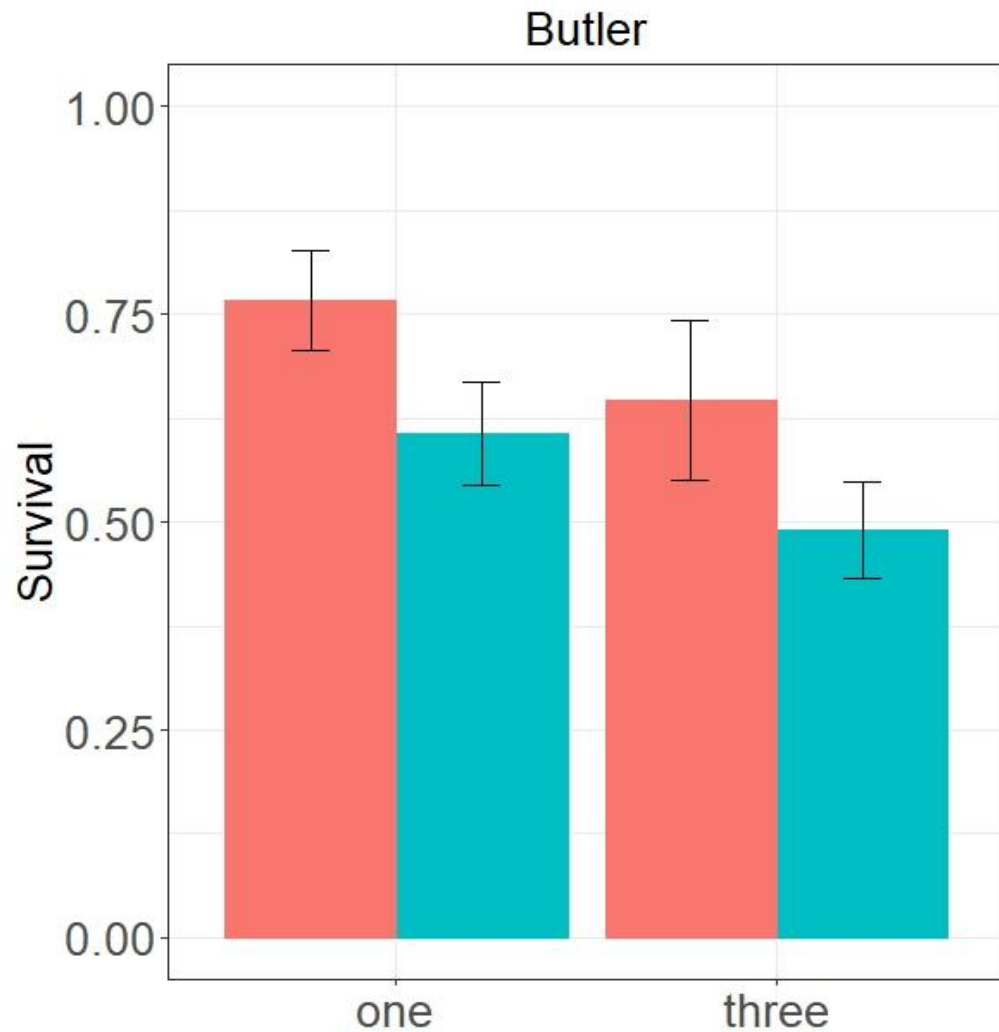


HydroCAT



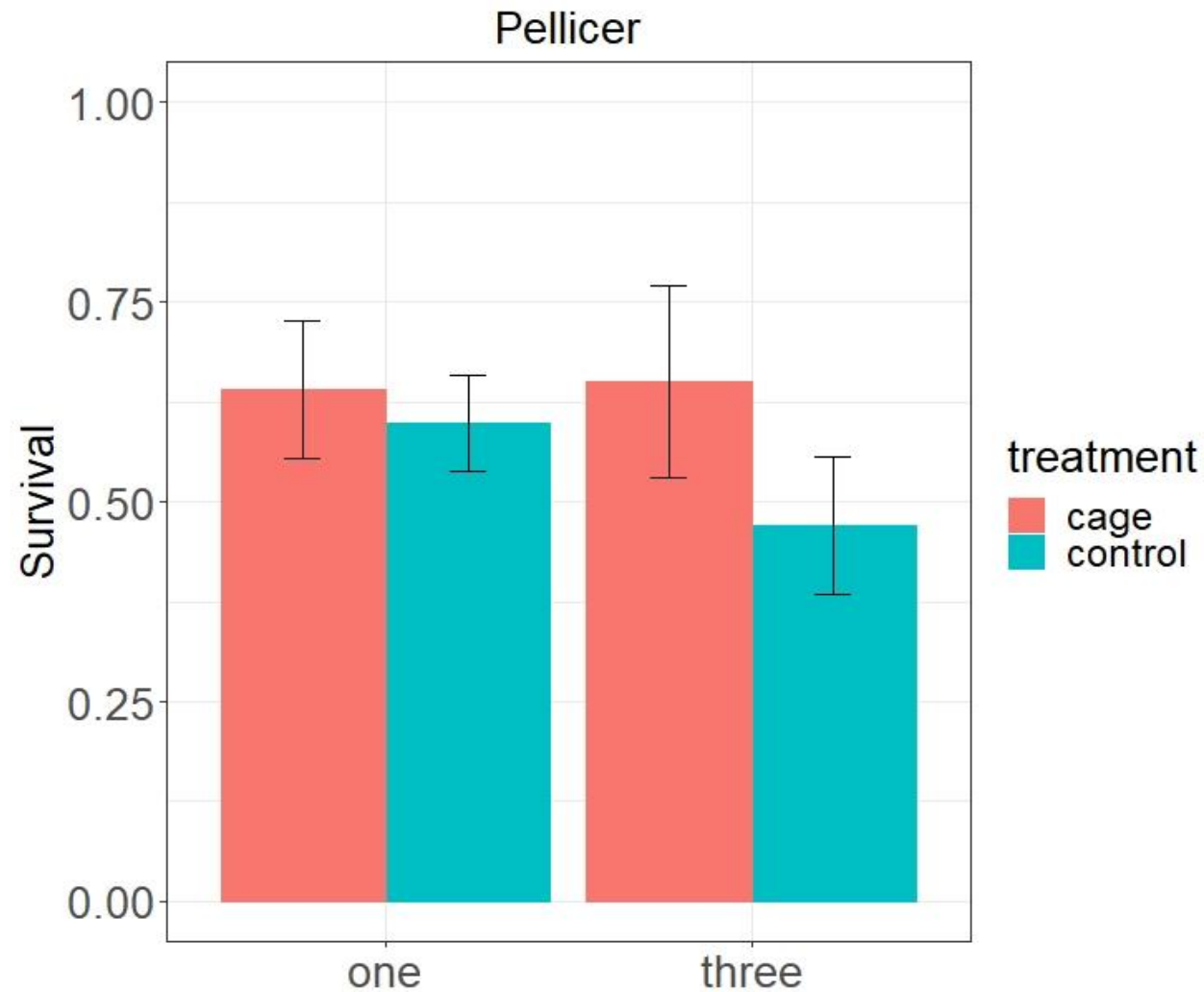
Xpp

Predation at Each Site



Paired t-test
 $t = 1.9996$, $df = 9$,
 $p\text{-value} = 0.0766$

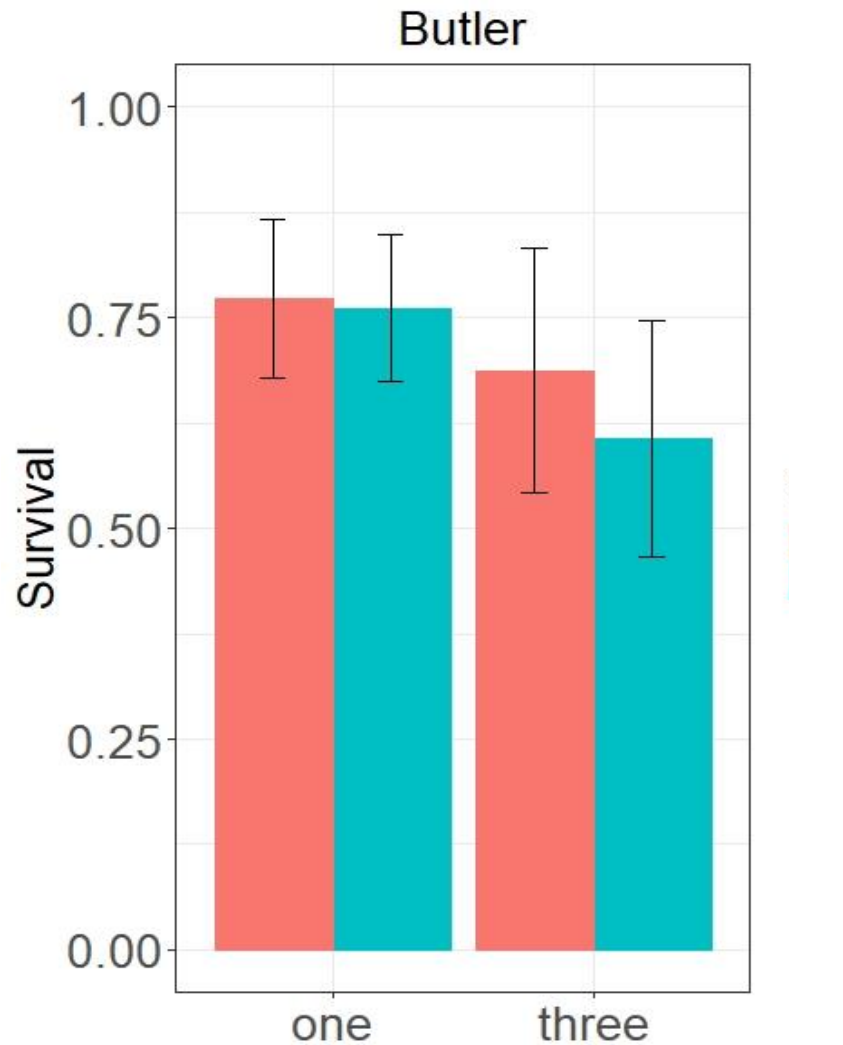
Paired t-test
 $t = 1.1891$, $df = 9$,
 $p\text{-value} = 0.2648$



Paired t-test
 $t = 0.40343$, $df = 9$,
 $p\text{-value} = 0.696$

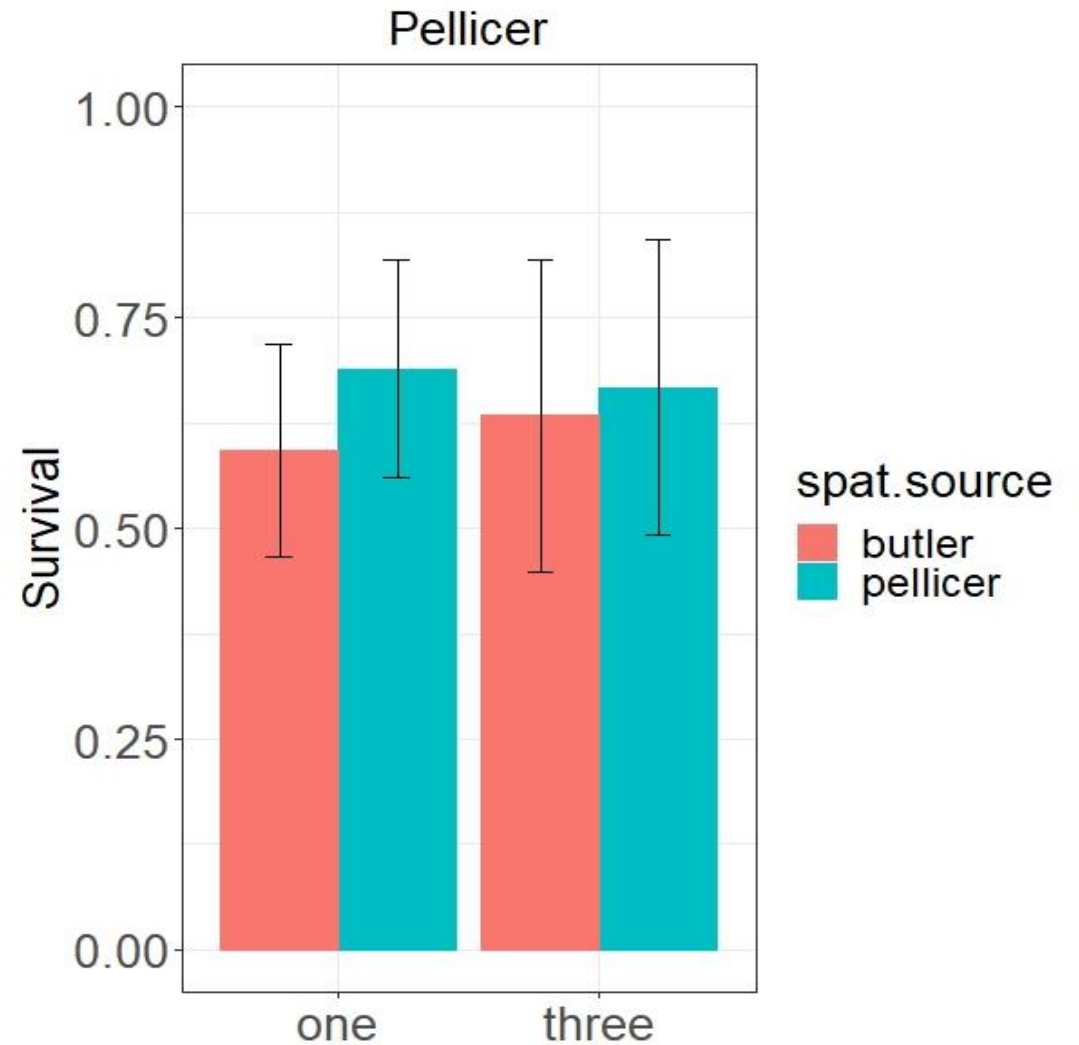
Paired t-test
 $t = 1.1001$, $df = 9$,
 $p\text{-value} = 0.2998$

Does Spat Source Matter for Survival?



Paired t-test
 $t = 0.13289$, $df = 4$,
 $p\text{-value} = 0.9007$

Paired t-test
 $t = 0.72166$, $df = 4$,
 $p\text{-value} = 0.5104$

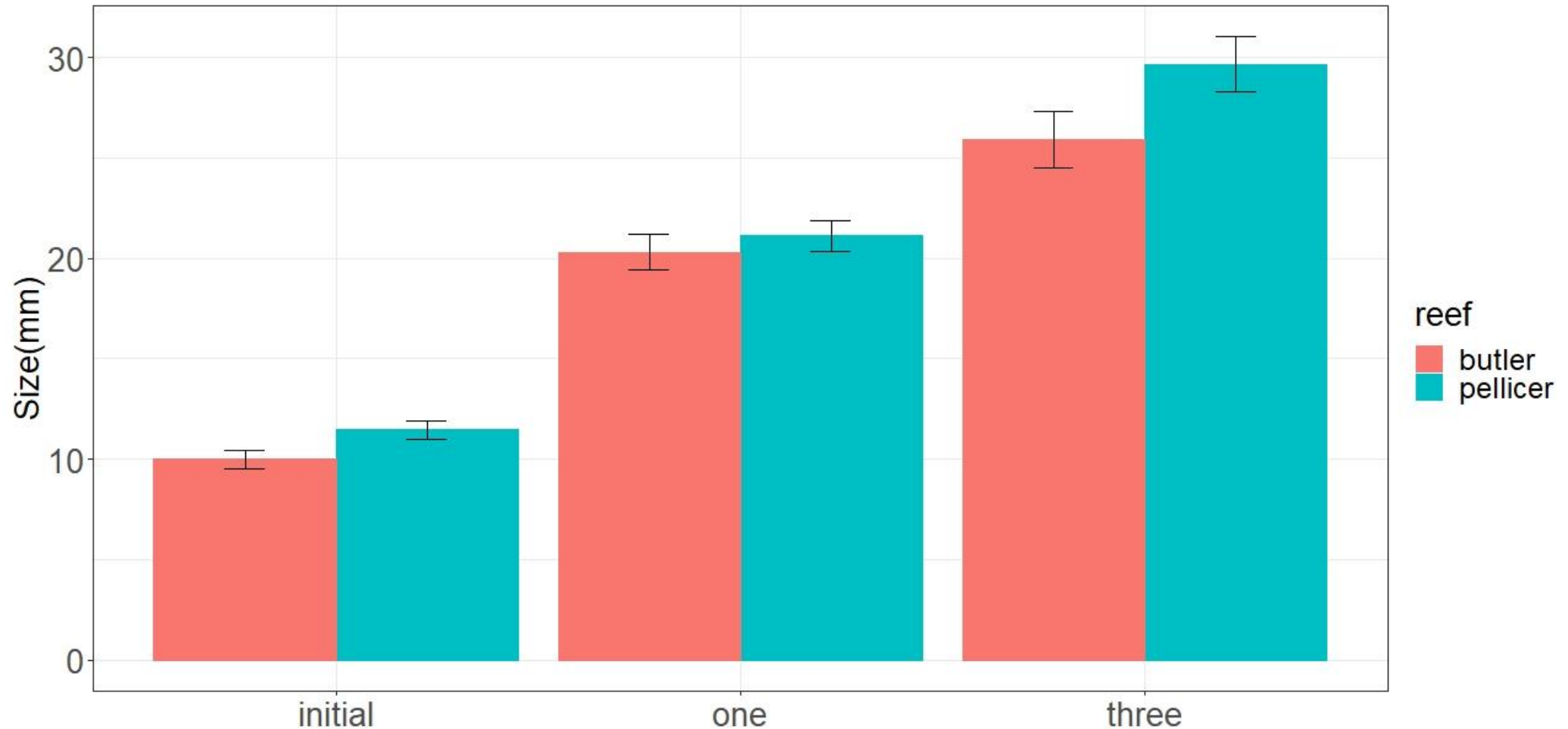


Paired t-test
 $t = -0.46863$, $df = 4$,
 $p\text{-value} = 0.6637$

Paired t-test
 $t = -0.11471$, $df = 4$,
 $p\text{-value} = 0.9142$

spat.source
butler
pellicer

Does Spat Grow Larger at One Reef or Another?



Paired t-test

$t = -0.69053$, $df = 19$, $p\text{-value} = 0.4982$

Paired t-test

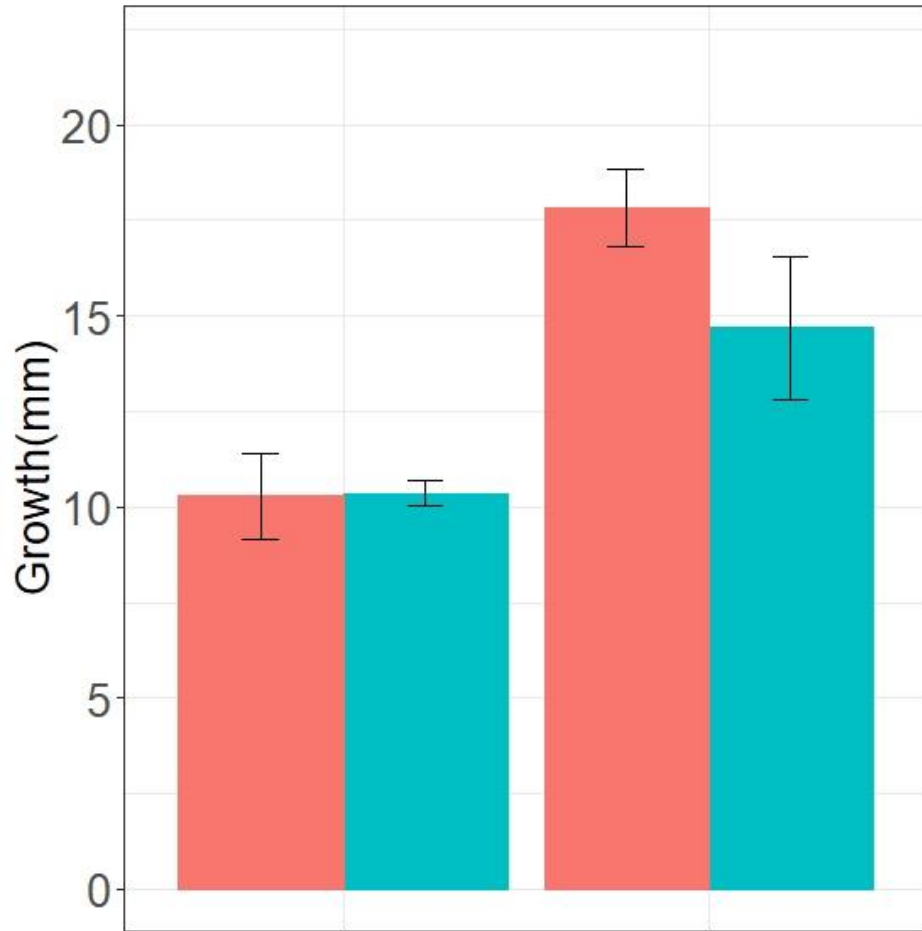
$t = 0.46362$, $df = 19$, $p\text{-value} = 0.6482$

Welch Two Sample t-test

$t = -0.73393$, $df = 33.642$, $p\text{-value} = 0.4681$

Do Spat from Different Reefs Grow More?

Butler



one

Paired t-test

$t = -0.066854$, $df = 4$,

$p\text{-value} = 0.9499$

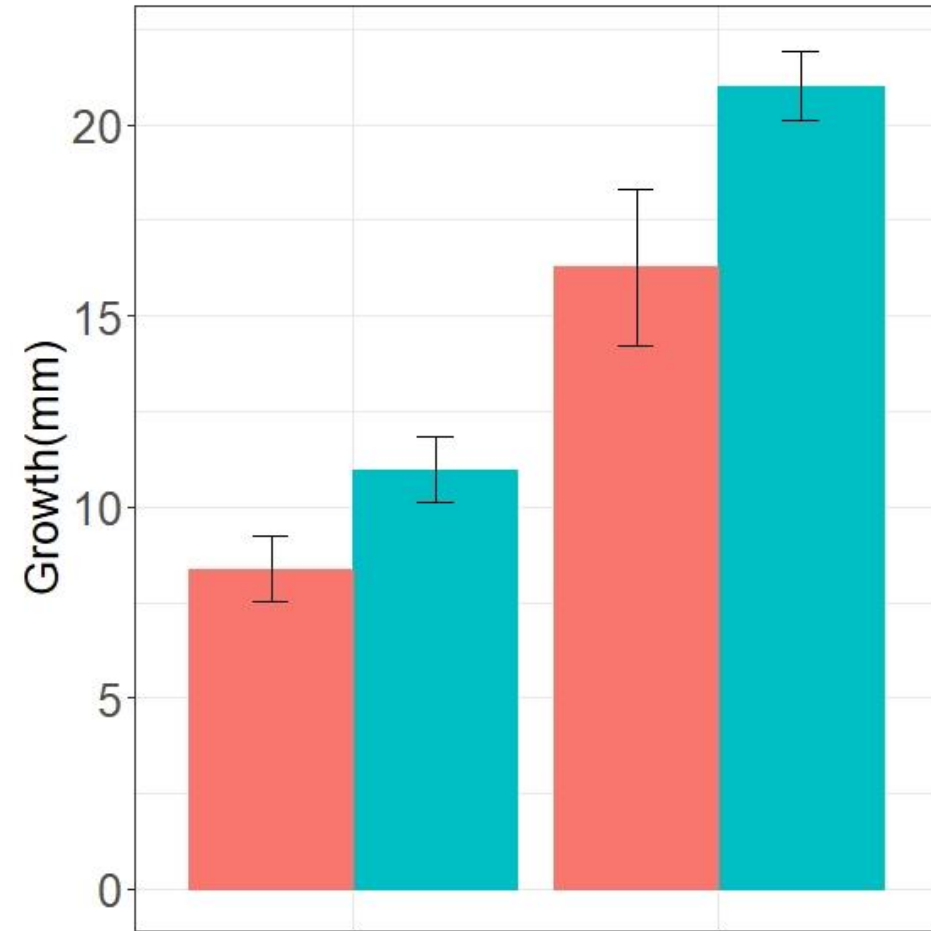
three

Paired t-test

$t = 1.5553$, $df = 4$,

$p\text{-value} = 0.1949$

Pellicer



one

Paired t-test

$t = -2.0845$, $df = 4$,

$p\text{-value} = 0.1055$

three

Paired t-test

$t = -1.9709$, $df = 3$,

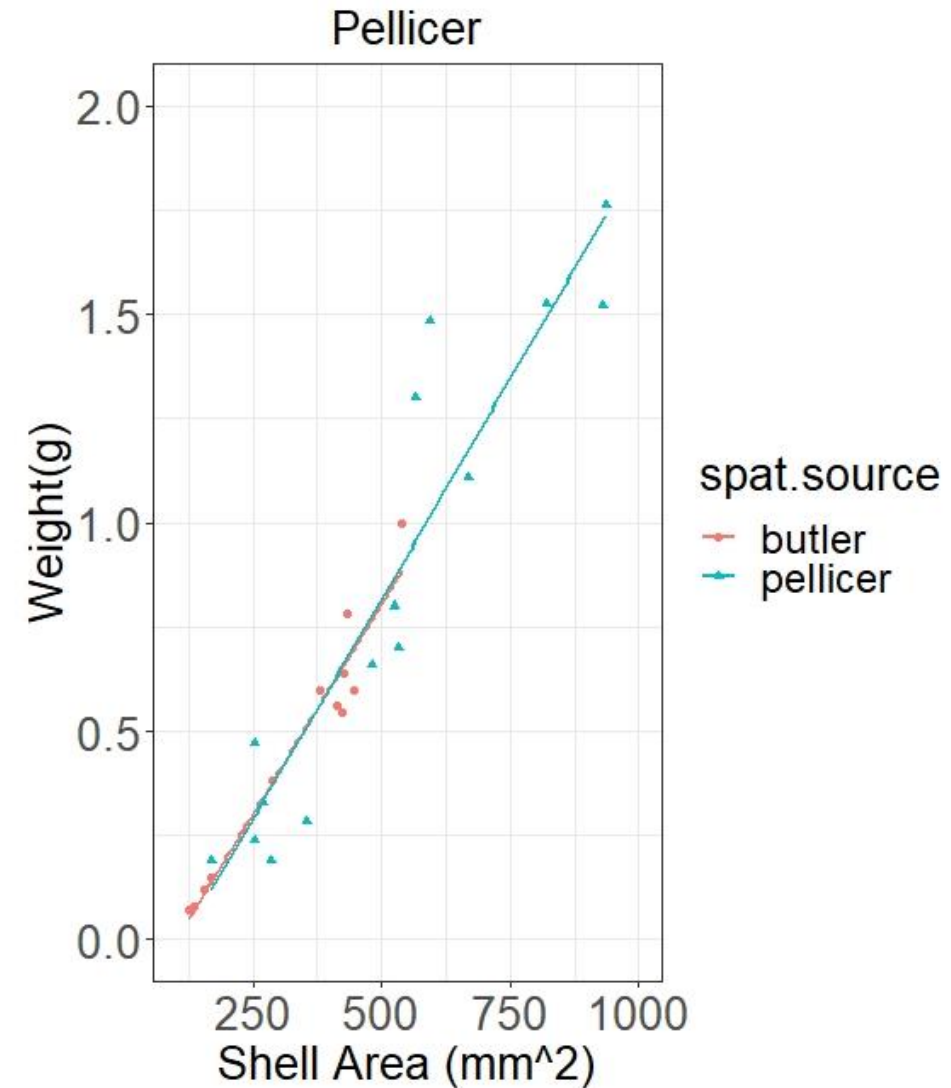
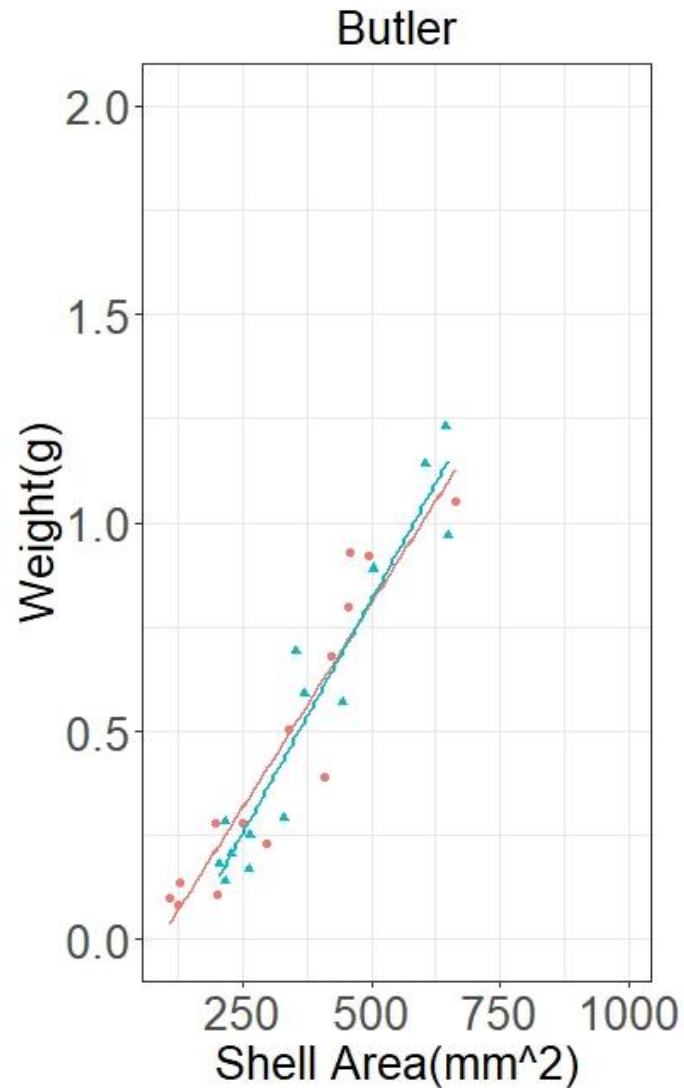
$p\text{-value} = 0.1433$

spat.source

butler

pellicer

Are oysters putting more resources into building a heavier shell?



Still More to Come: Destructive Sampling

Shell Strength

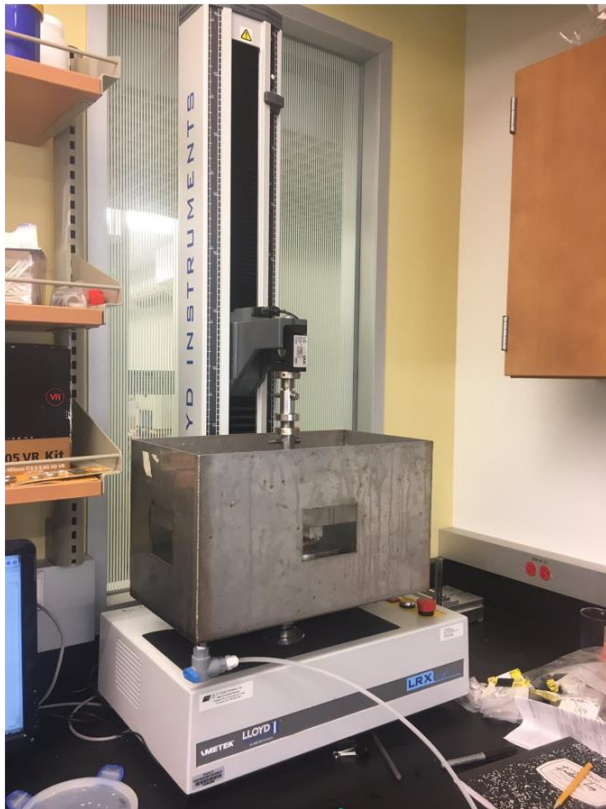


Photo by: Louise Cameron

Health of the Oyster- Condition Index



Photo by: Susan Ford

Shell Chemistry



Photo by:
<https://www.fisheries.noaa.gov/feature-story/how-will-changing-ocean-chemistry-affect-shellfish-we-eat>

The background image shows a rocky shoreline with several people in the distance. One person is wearing a light blue jacket and a white hat, another is in a dark blue shirt, and a third is in a white shirt. They appear to be engaged in some activity, possibly related to the restoration project mentioned in the text. The water is visible on the left side, and the sky is overcast.

Conclusions and Next Steps

- Trend towards local adaptation in growth but not survival
- Source of the spat may need to be another factor to consider when establishing a restoration project

Thank you

- Dr. David Kimbro
- Cade Cresap
- Nicole Peckham
- Allison Noble
- GTM Staff



Questions?

