

Stakeholder driven modeling to understand oyster population sustainability

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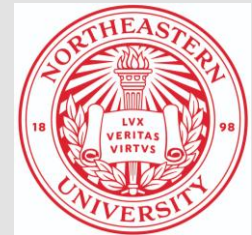
² GTMNERR

³ Northeastern University

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NATIONAL
ESTUARINE
RESEARCH
RESERVE
SYSTEM



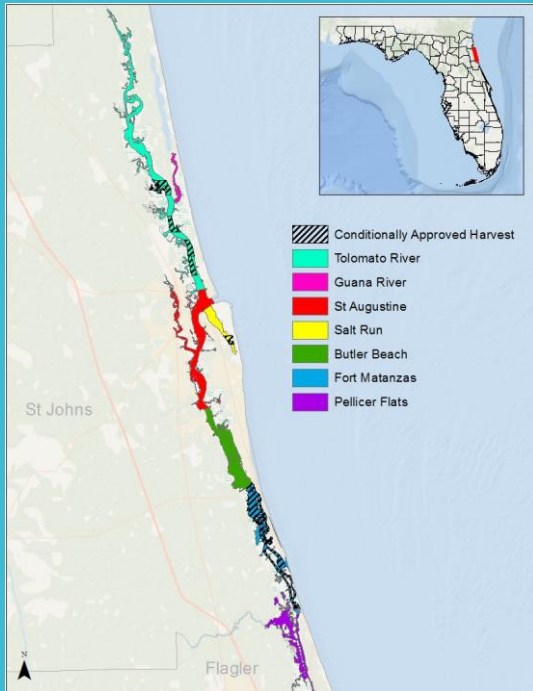
Oregon State University
Coastal Oregon Marine
Experiment Station

Using Models to Inform Sustainability

- Why use models?
 - Oyster population numbers depend on...
 - **Mortality**
 - **Harvesting**
 - **Growth**
 - **Environmental factors**
 - etc...
 - We can use a model to put all of these pieces together and see how they affect oyster sustainability



Photo: Adrienne Breef-Pilz



- Of the seven regions...
 - Differences in growth, mortality, predation, and size distribution?
 - Which locations are most likely to support stable population numbers when harvested?
 - Where are good target locations for restoration?

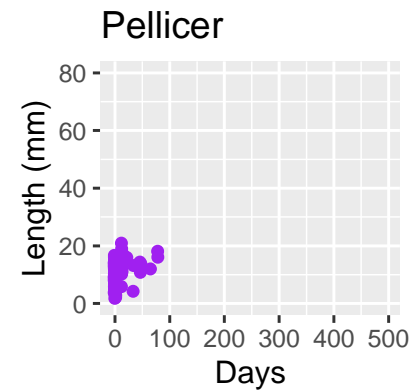
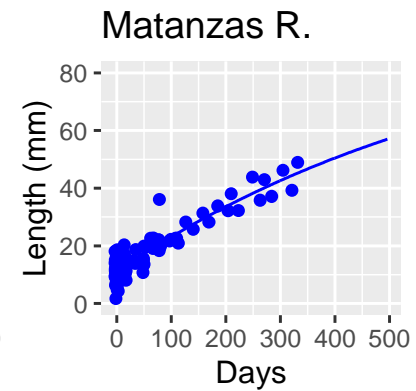
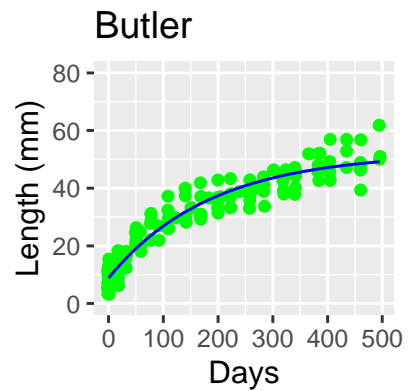
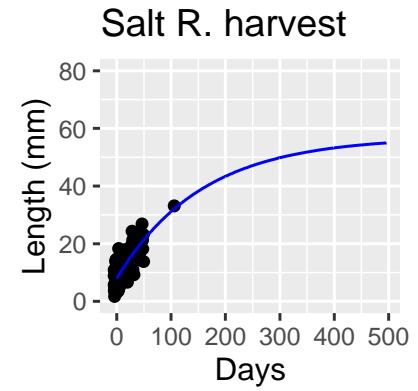
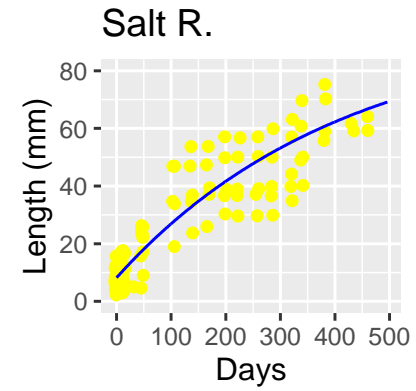
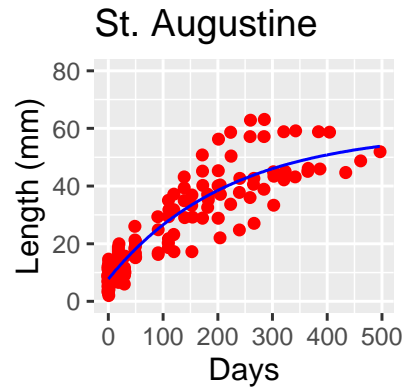
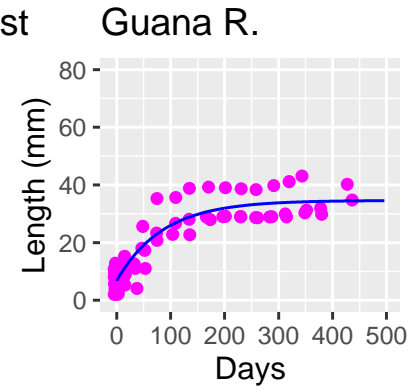
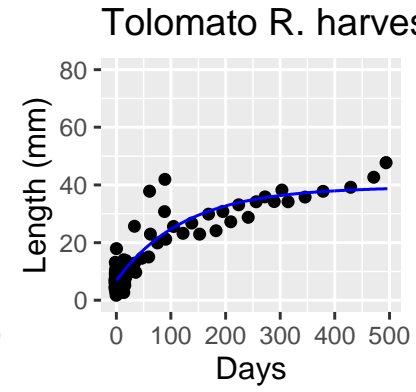
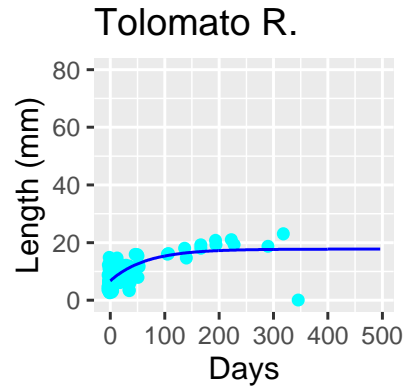
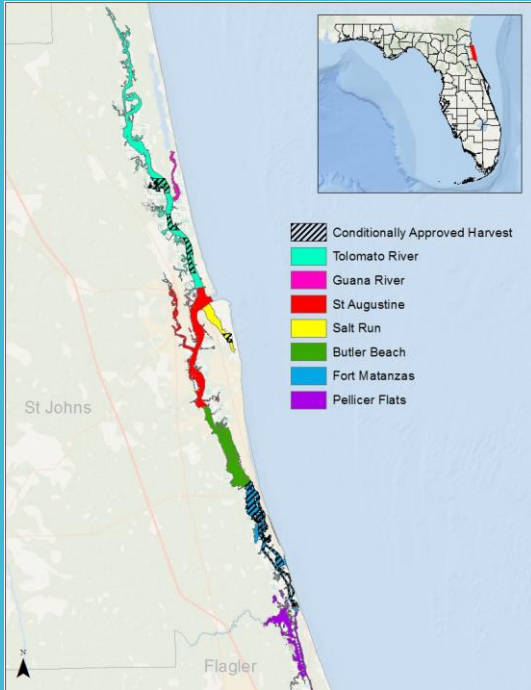
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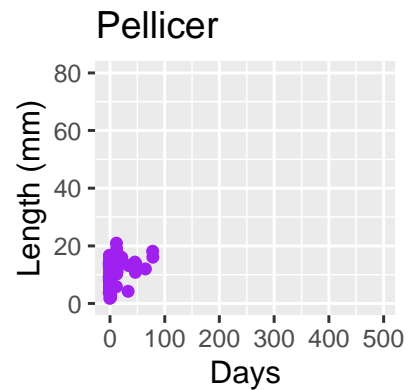
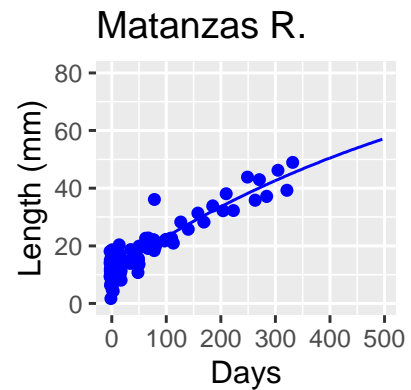
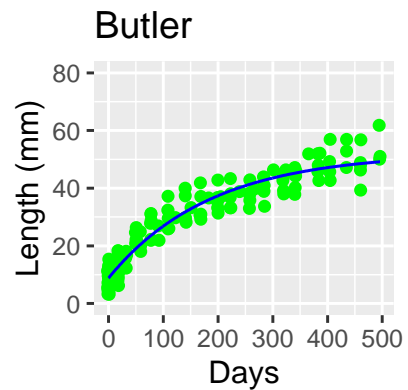
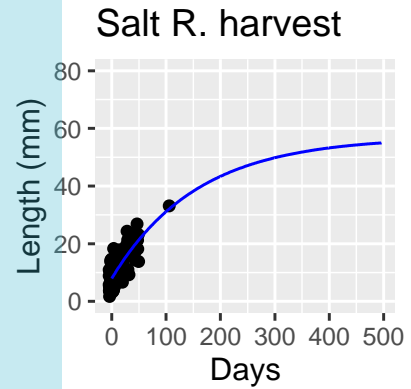
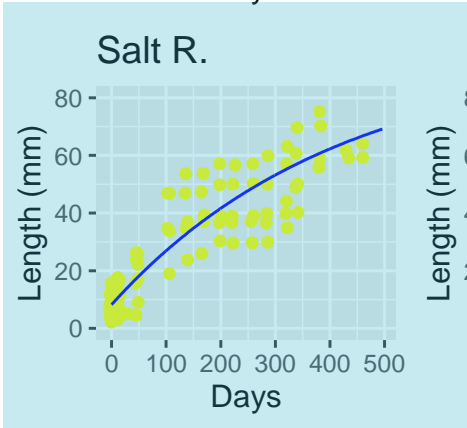
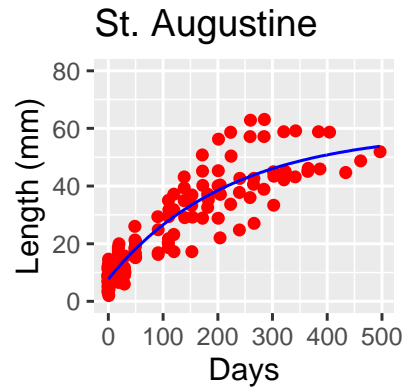
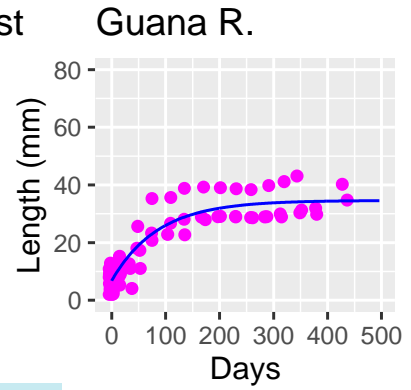
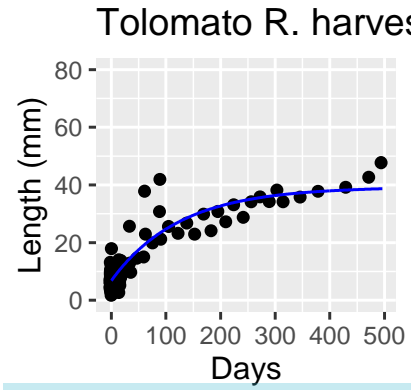
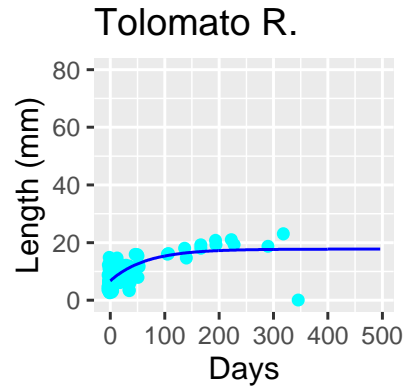
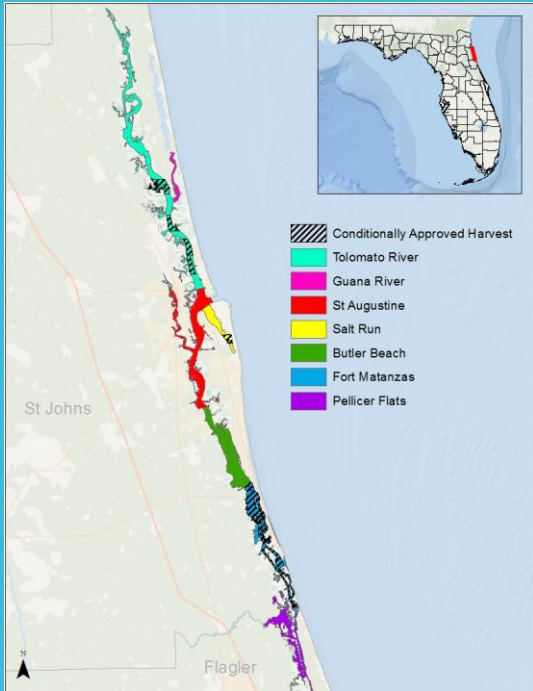
Photo: Adrienne Breef-Pilz

- For 9 locations throughout GTMNERR:
 - Growth, natural mortality (spat in cages), predation (spat outside of cages), environmental data
 - Growth data since 2018
 - Mortality data since May 2019
 - Growth and mortality data will inform an oyster **size distribution model**
- Data collected by the Kimbro lab

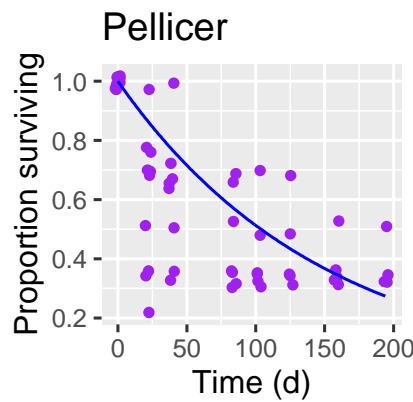
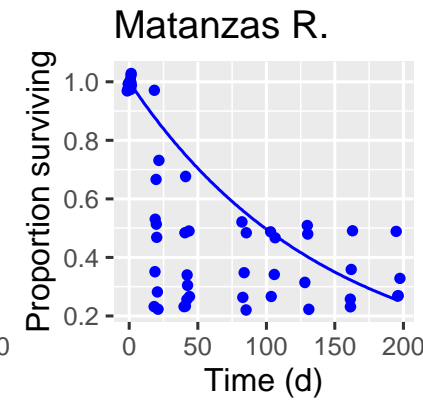
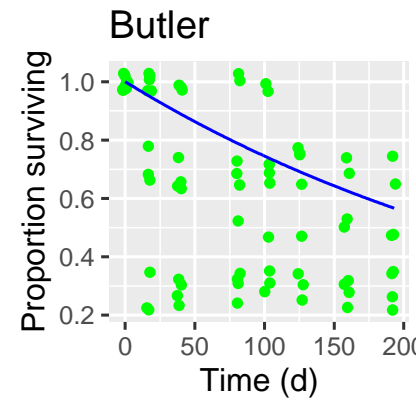
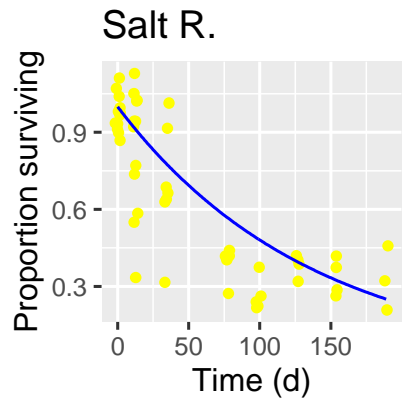
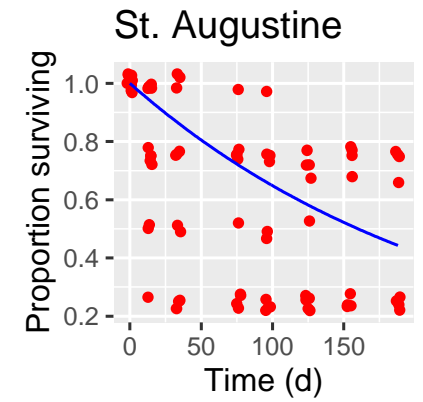
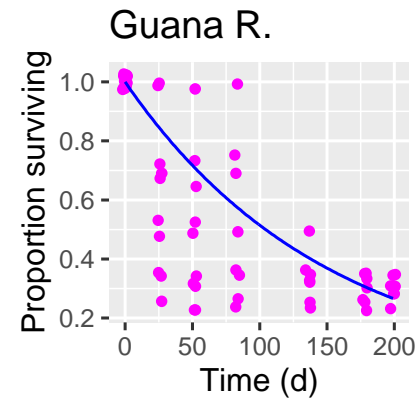
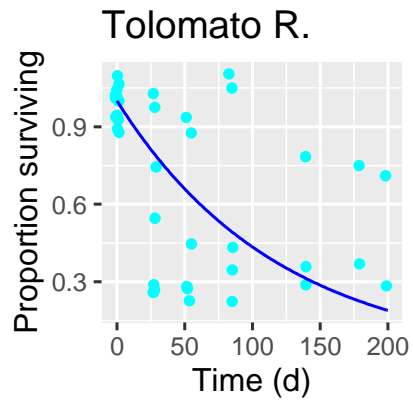
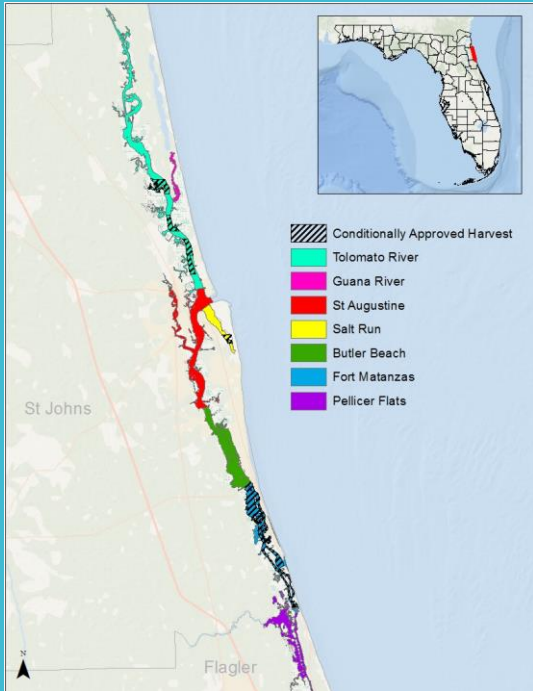
Growth Results



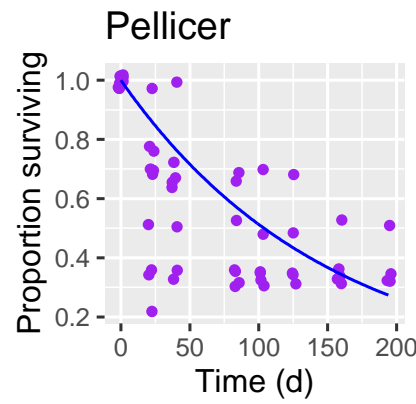
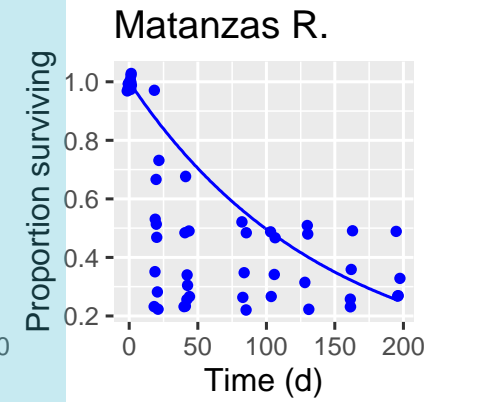
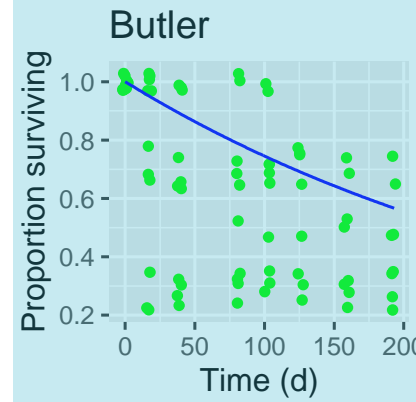
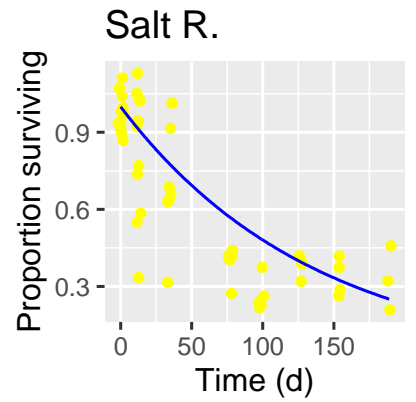
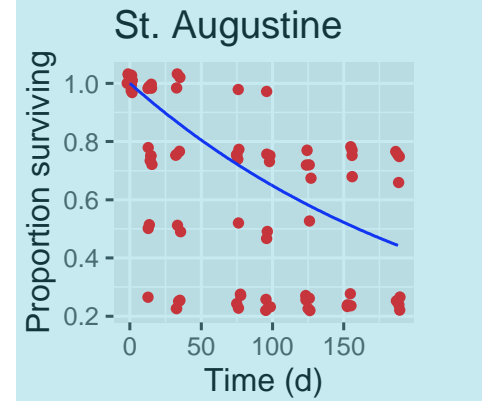
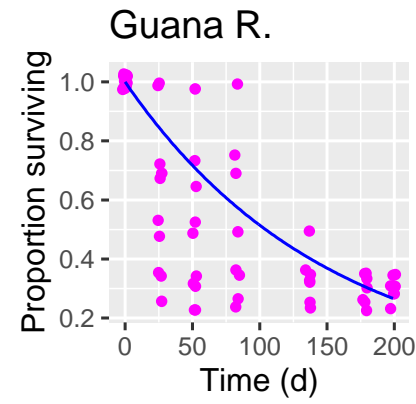
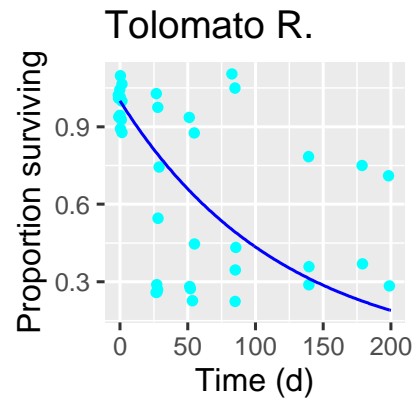
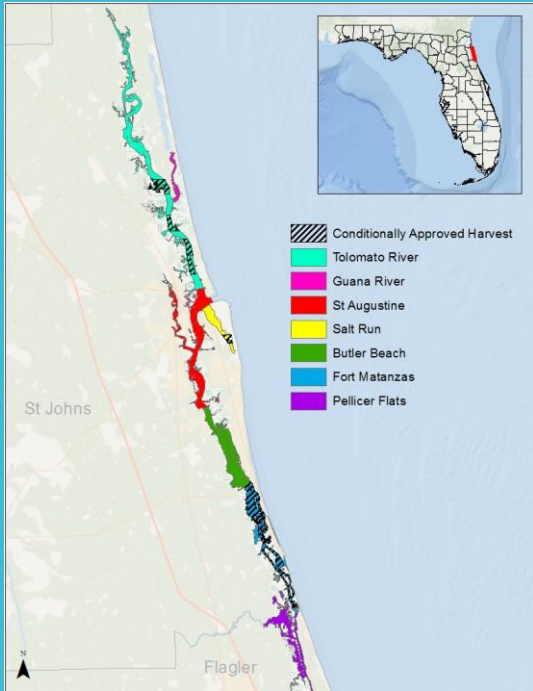
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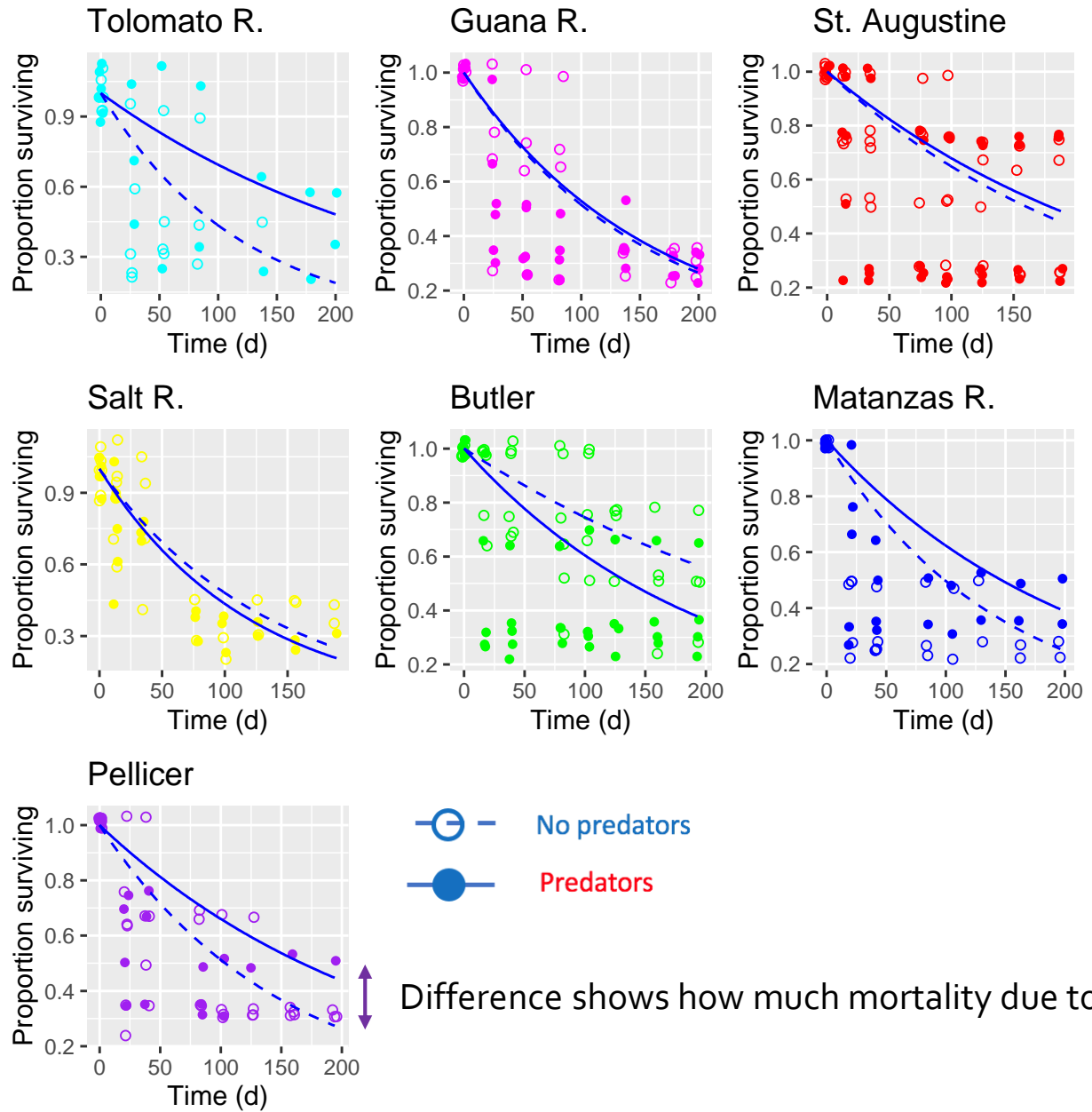
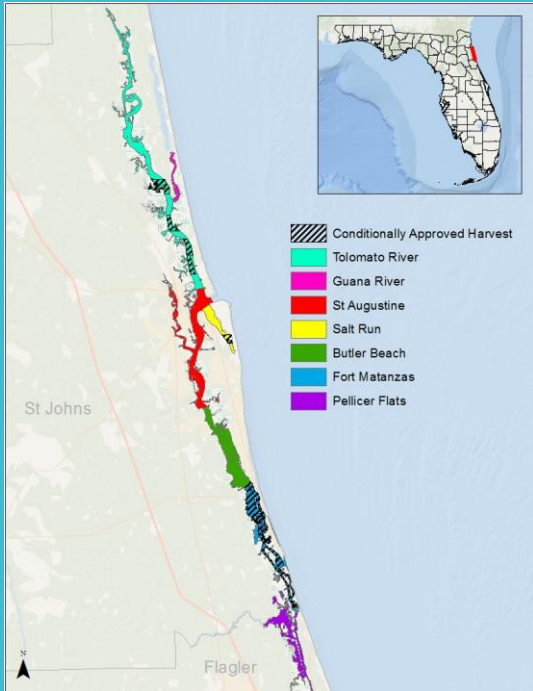
Survival Results



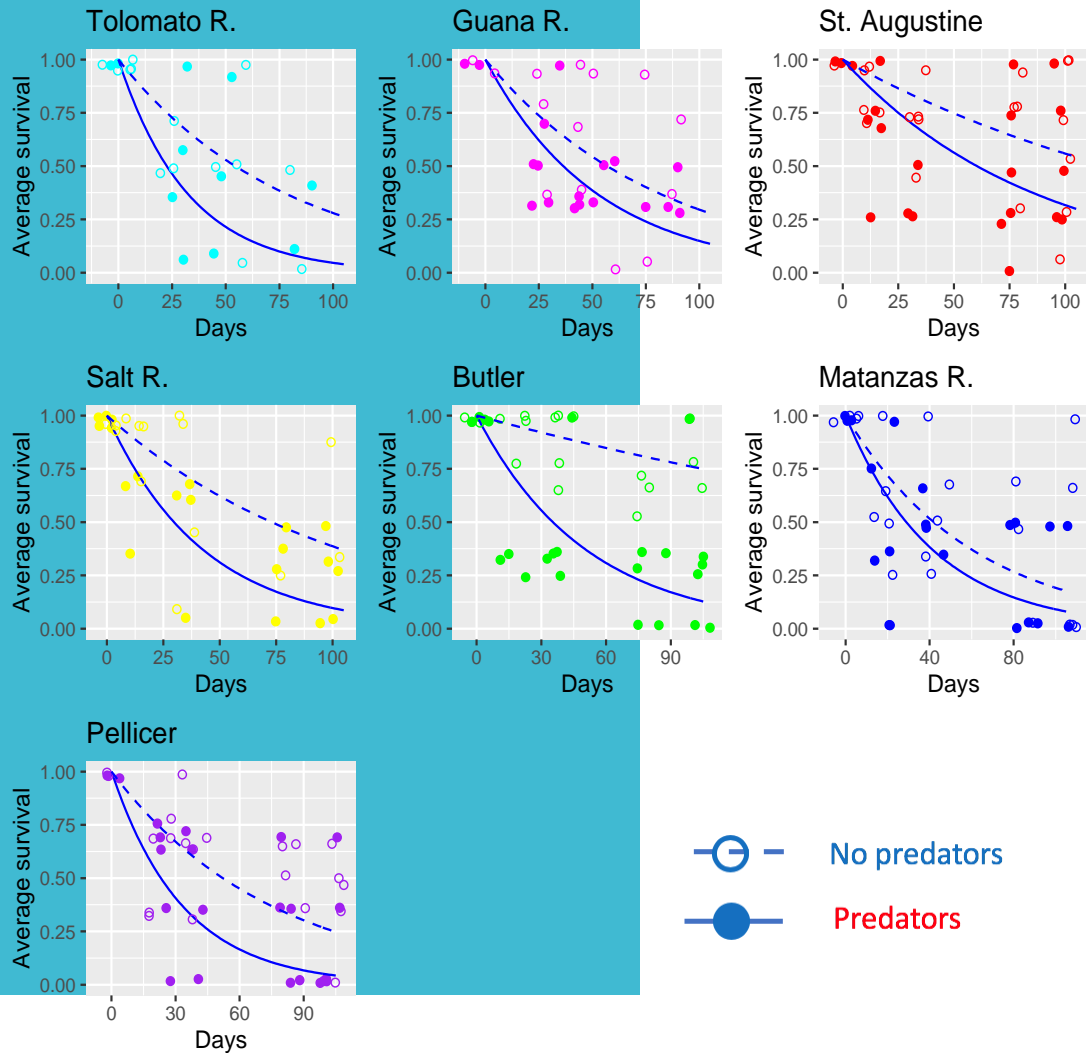
Survival Results



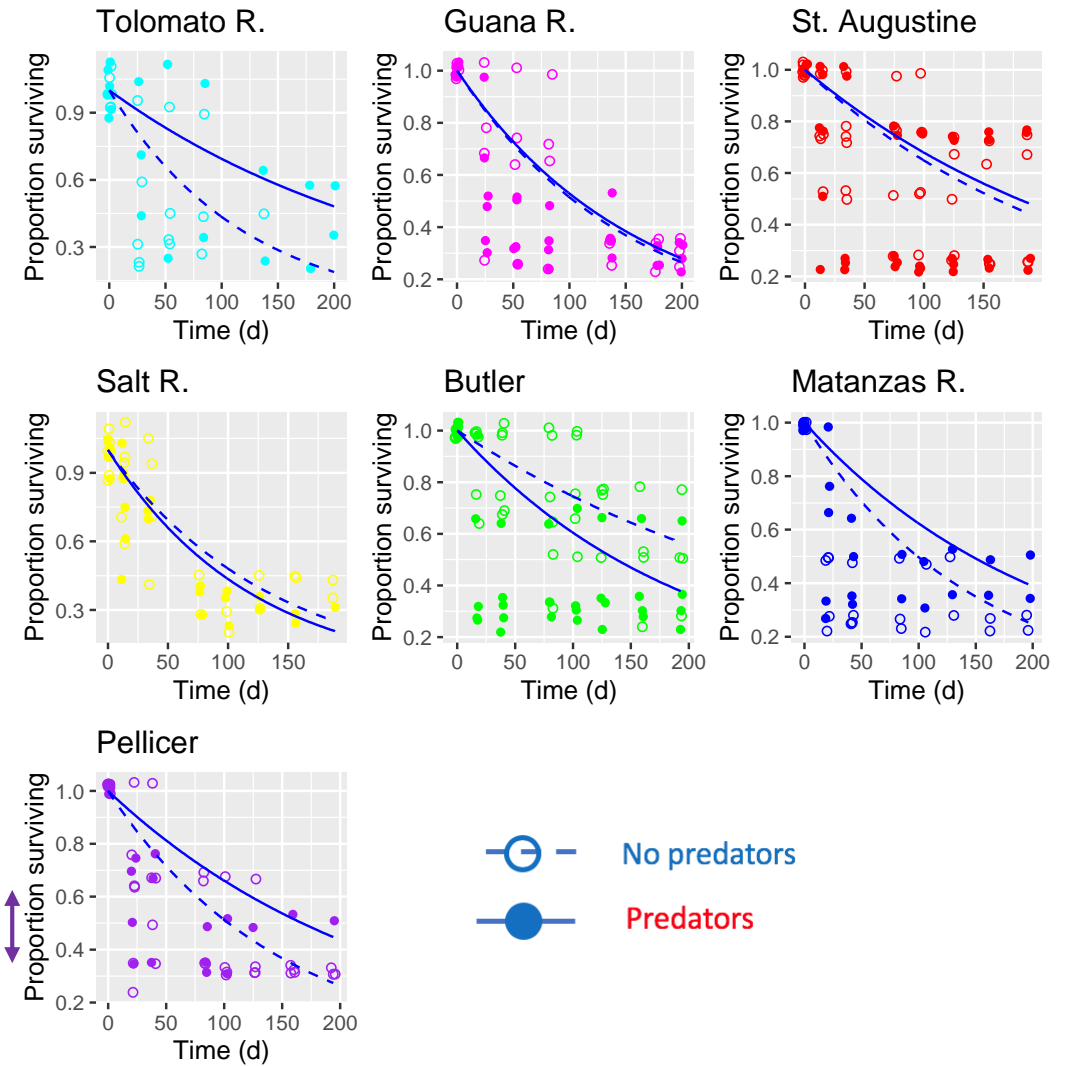
Survival Results



Juvenile (first 100 days) mortality



Additional 100 days



Size structured oyster model

- **Integral projection model** to estimate **eggs per recruit** and **stable size distributions** for the GTMNERR sites

- Basic IPM form:

$$N(y, t + 1) = \int K(y, x)N(x, t)dt$$

- $N(x, t)$ = abundance of individuals of size x at time t
- $K(y, x)$ = probability of growing from size x to size y (probability kernel) in one model iteration. Incorporates **growth** information, **survival** information, and **reproduction**
- Integrate over biologically reasonable sizes

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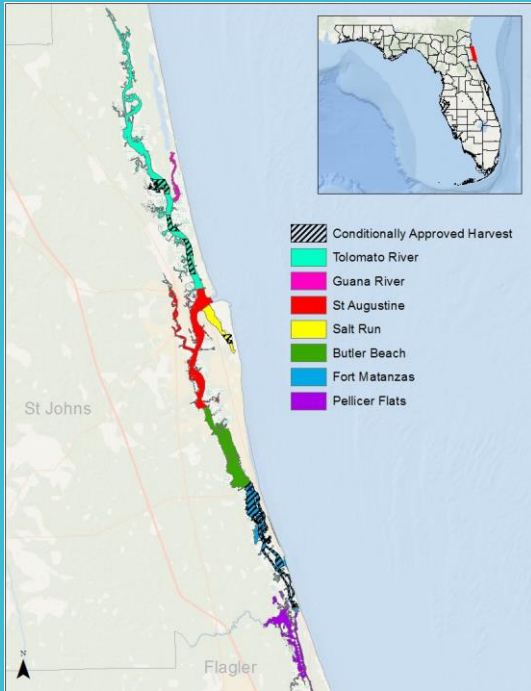
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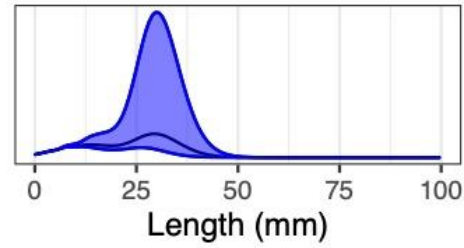
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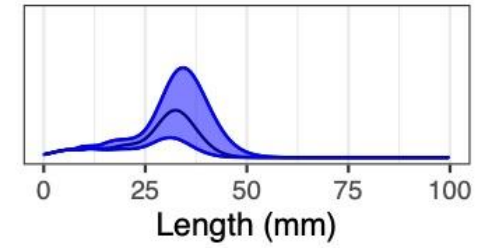
Model results



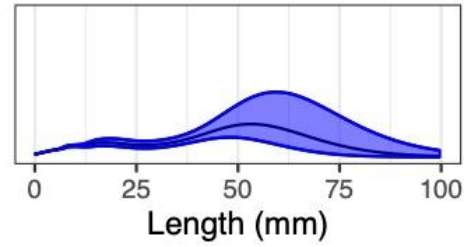
Tolomato



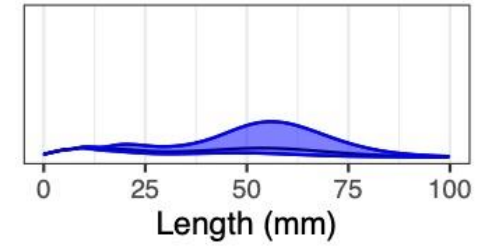
Guana



St. Augustine

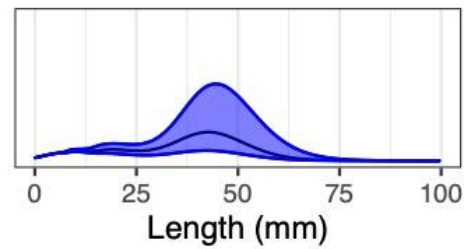


Salt

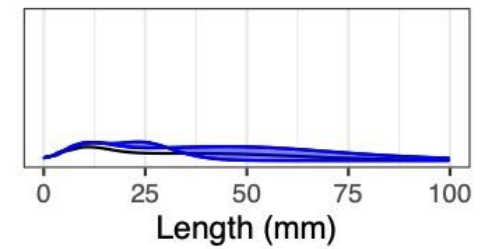


Relative abundance

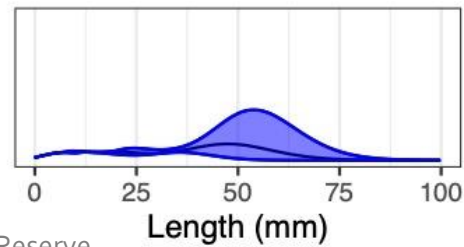
Butler



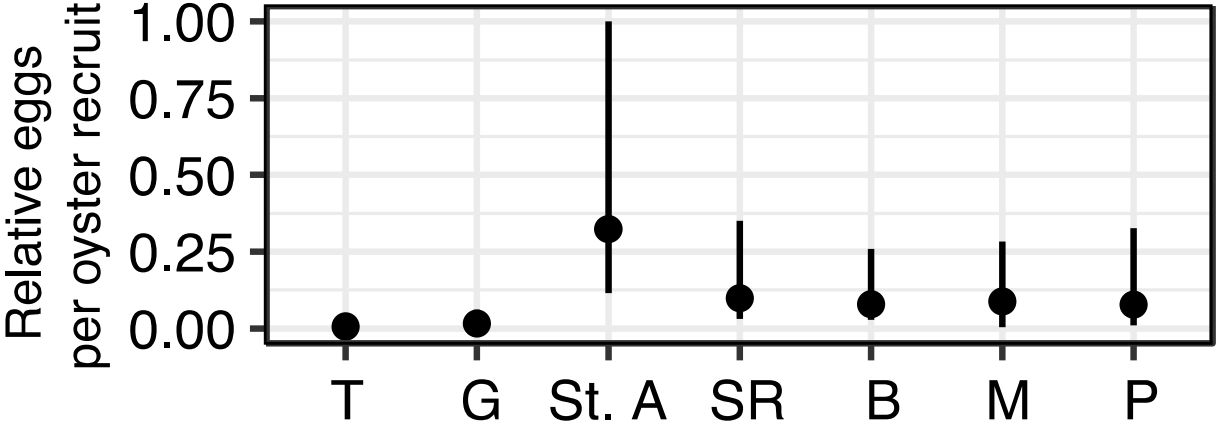
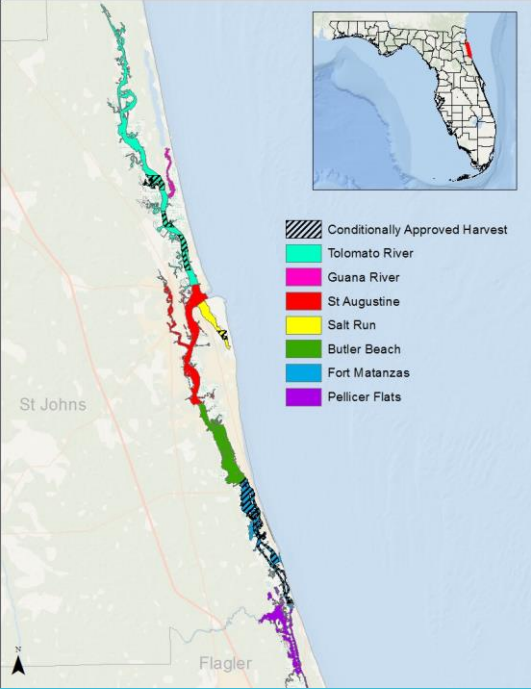
Matanzas



Pellicer



Model results



Take-home messages



Photo: Adrienne Breef-Pilz

- Growth and mortality vary greatly by region
- Productivity greatest near the inlet
- Limitations:
 - Data limitations: Model outputs are based on small sample sizes per site, confidence in results will increase with more data
 - Ongoing work in the GTM collecting data
- **Future work:**
 - If we focus restoration efforts in the productive regions (St. Augustine), will this promote healthier oyster populations in other regions?
 - Kimbro lab investigating water quality and oyster growth and reproduction
 - Kimbro & White labs investigating predator-prey interactions

Thank you!