Integrating Oyster Recruitment Dynamics with Alternative Materials for Shellfish-Based Living Shorelines in the Delaware Bay

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- **Clean Waters**
  - Nutrient Pollutants
  - Other Pollutants
  - Sustain Flow
- **Strong Communities**
  - Resilience and Access
  - Engagement
- **Healthy Habitats**
  - Wetlands
  - Forests
  - Fish & Shellfish

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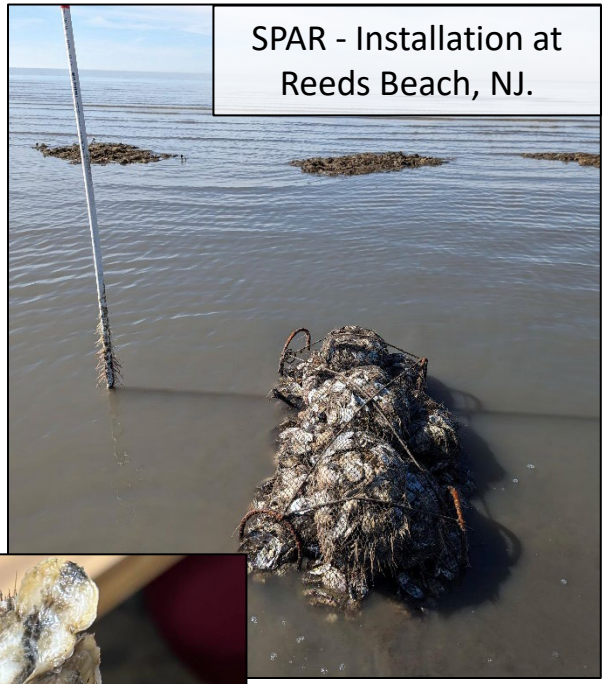
One Project, Two Studies

Shell bag Plastic Alternative Research (SPAR)

PDE, Rutgers University, American Littoral Society, US Fish & Wildlife

Project Goal: Explore how environmental factors influence the structural integrity of three novel, non-plastic shell bag materials in comparison to traditional plastic material.



SPAR - Installation at Reeds Beach, NJ.

Shellfish Recruitment Study (SRS)

PDE, University of Delaware

Project Goal: Assess wild recruitment of Eastern oyster (*Crassostrea* virginica) along geospatial and temporal gradients.

SRS - Recruitment on recycled oyster shell.

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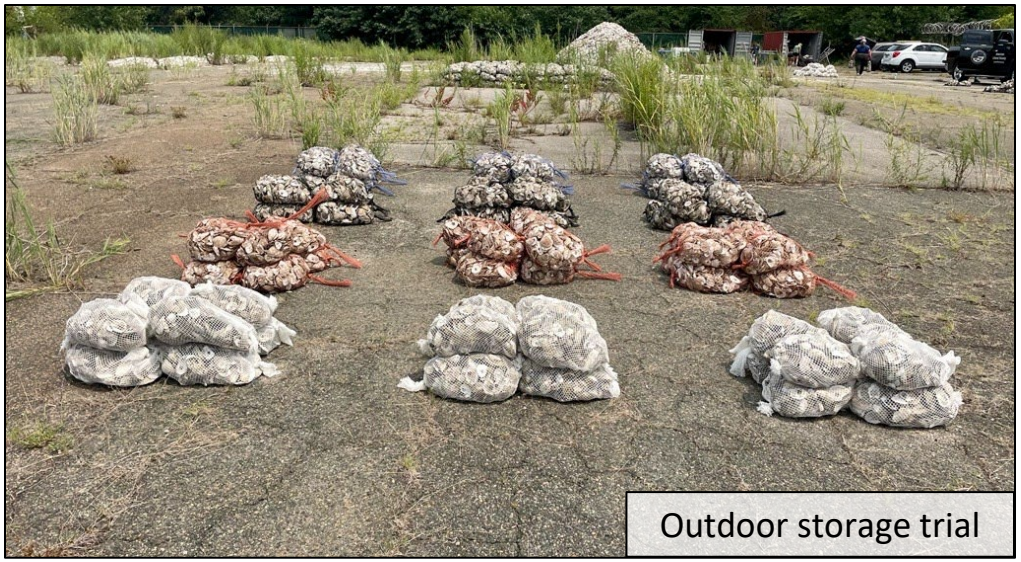
Shell bag Plastic Alternative Research (SPAR)



Outdoor storage trial

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SPAR
Materials Tested

1. Polyethylene (Plastic) Mesh
2. Biodegradable Beechwood Cellulose Mesh
3. Biodegradable Biopolymer Mesh
4. Biodegradable Co-polyester Mesh

1.

2.

3.

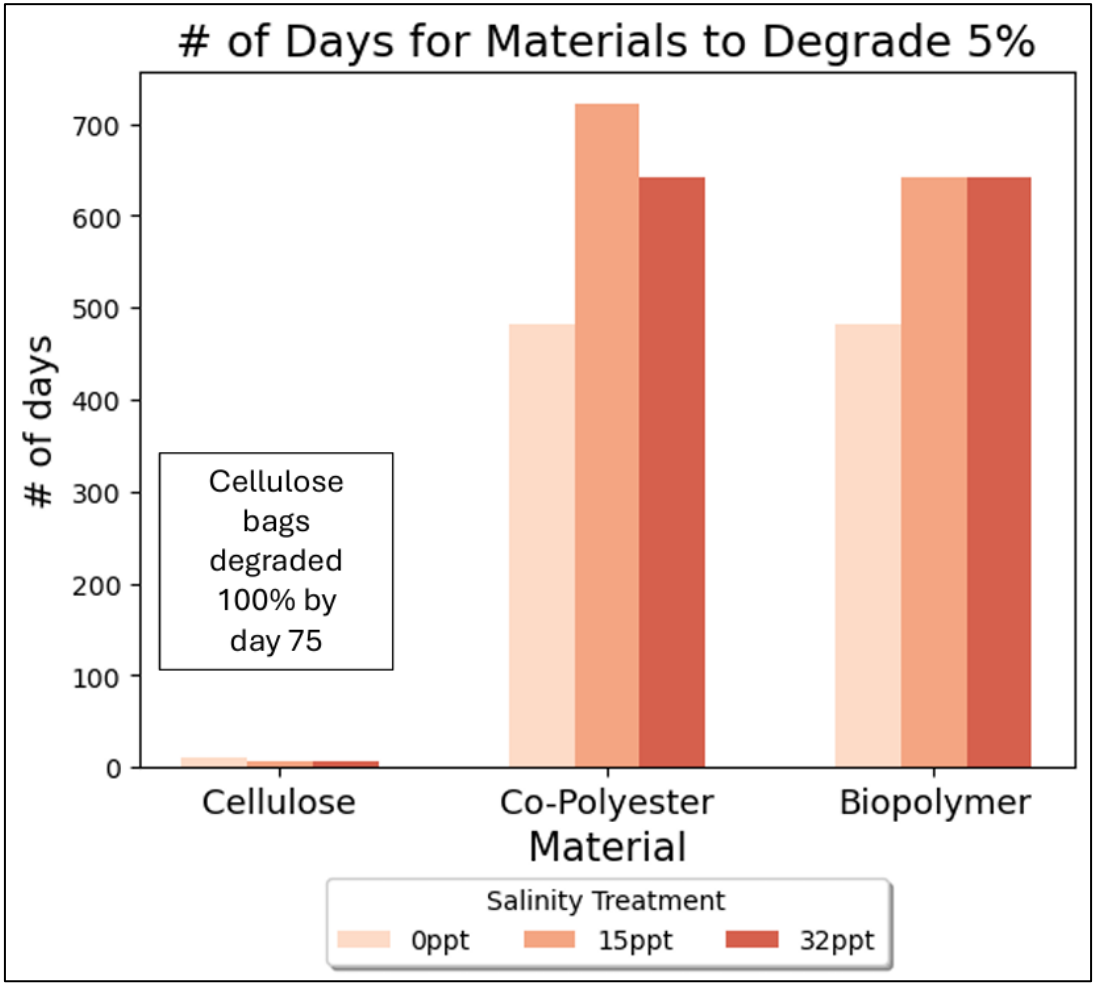
4.

SPAR
Methods and Metrics

- **Recirculating Raceway (Rutgers University)**
  - 0 ppt, 15 ppt, 32 ppt
  - Weight test (quantitative), visible degradation (qualitative)
- **Long-term Outdoor Storage (PDE)**
  - Outdoor vs. indoor conditions
  - Strength test (quantitative), visible degradation (qualitative)
- **Field Installations (PDE, Rutgers, USFWS, ALS)**
  - Freshwater and Estuarine installations
  - Visible degradation (qualitative), shellfish recruitment (quantitative)

SPAR Results
Recirculating Raceway Experiment

Note:
0 ppt raceway had highest exposure to sunlight and experienced high amounts of fouling



Data courtesy of Maya Lopez, Vassar University and Jenny Shinn, Rutgers University

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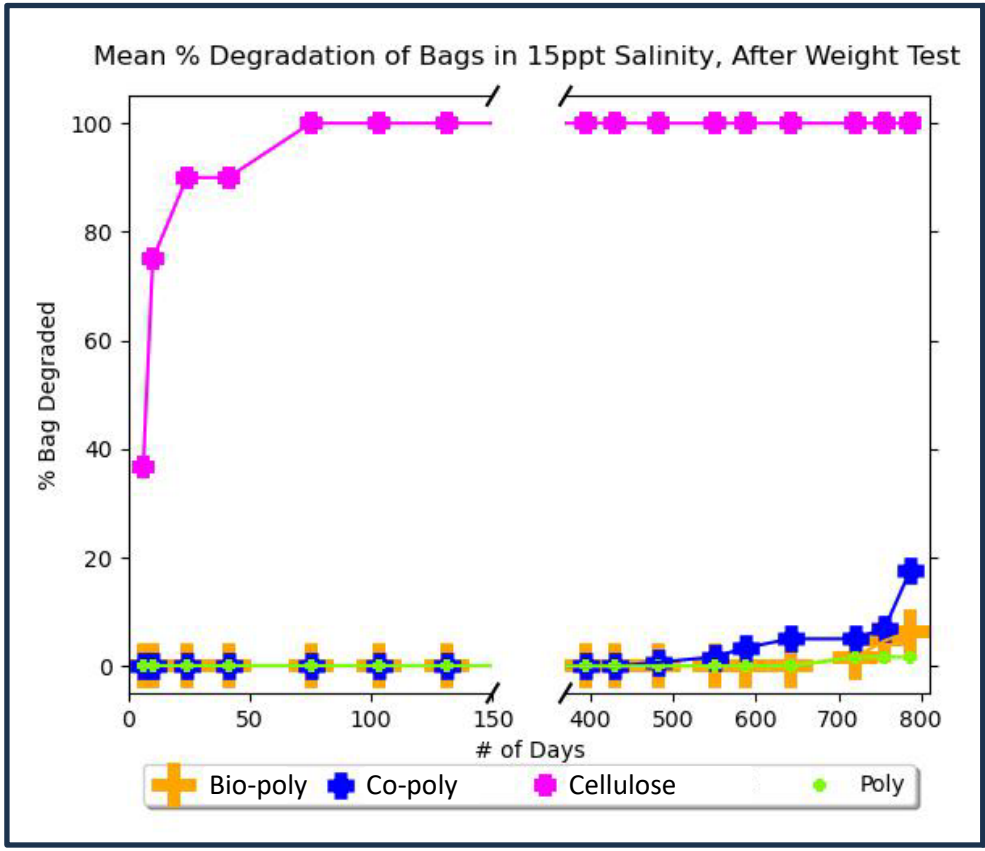
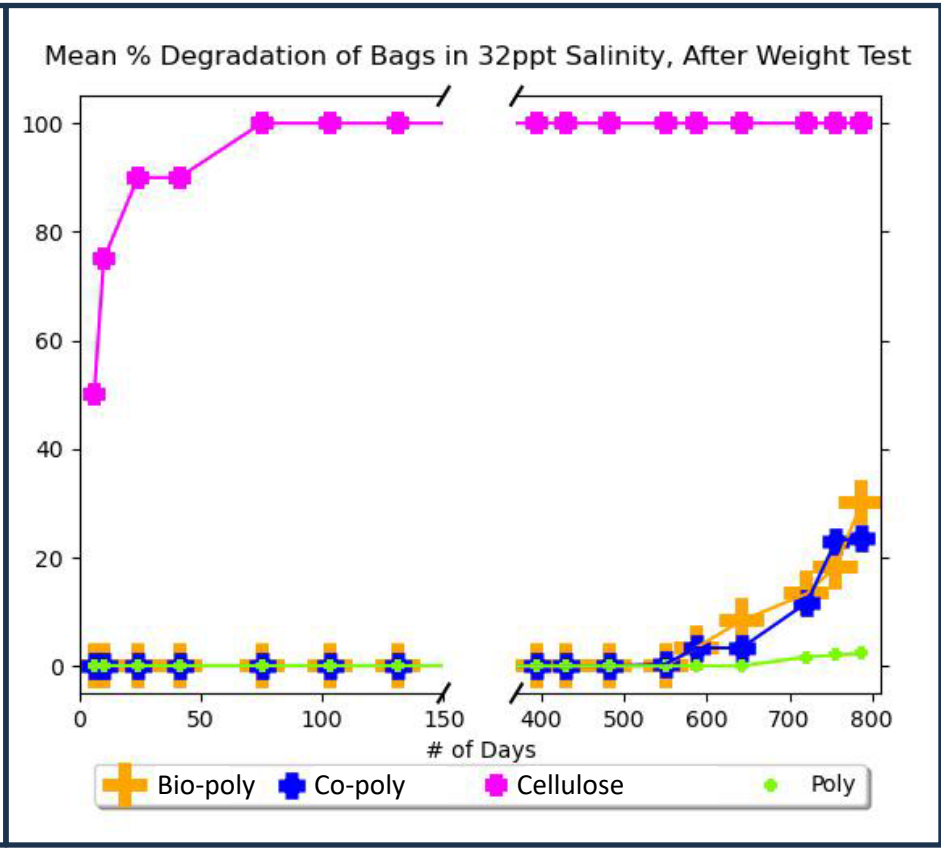
SPAR Results
Recirculating Raceway Experiment



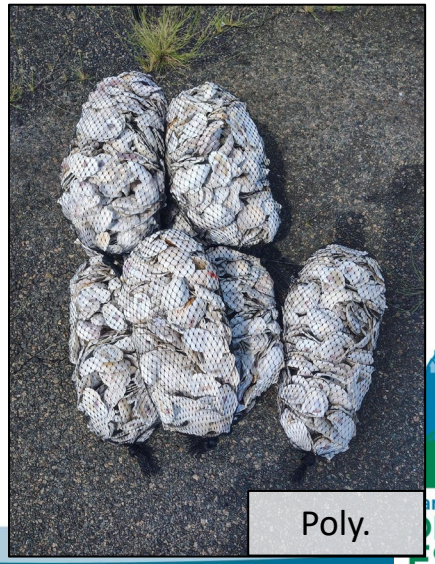


Data courtesy of Maya Lopez, Vassar University and Jenny Shinn, Rutgers University

SPAR Results
Outdoor Long-term Storage

Monitoring Period: 756 days
August 2022 – September 2025

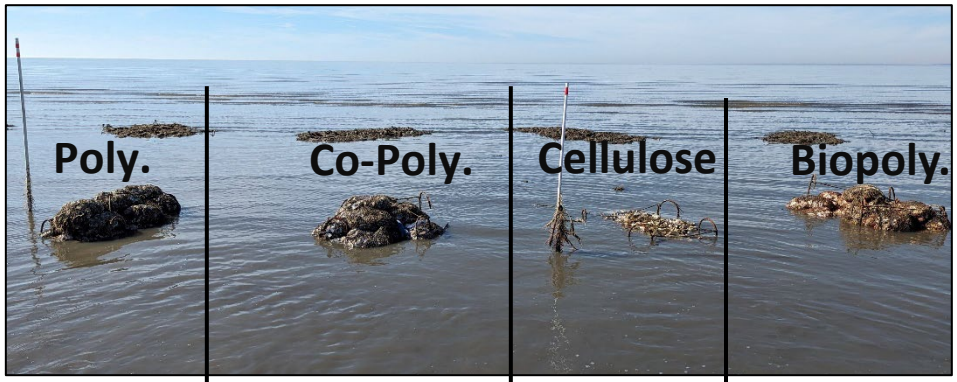
Cellulose: Failure at day 169
Co-poly.: Good condition
Biopoly.: Good condition
Poly.: Good condition



Photos courtesy of Toni Rose Tablante, JCNERR and Shane Godshall, ALS

SPAR Results
Estuarine Observations

Fall 2023



Fall 2024

Spring 2025

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Shellfish Recruitment Study (SRS)

Oysters growing on shell bags in Delaware Bay.

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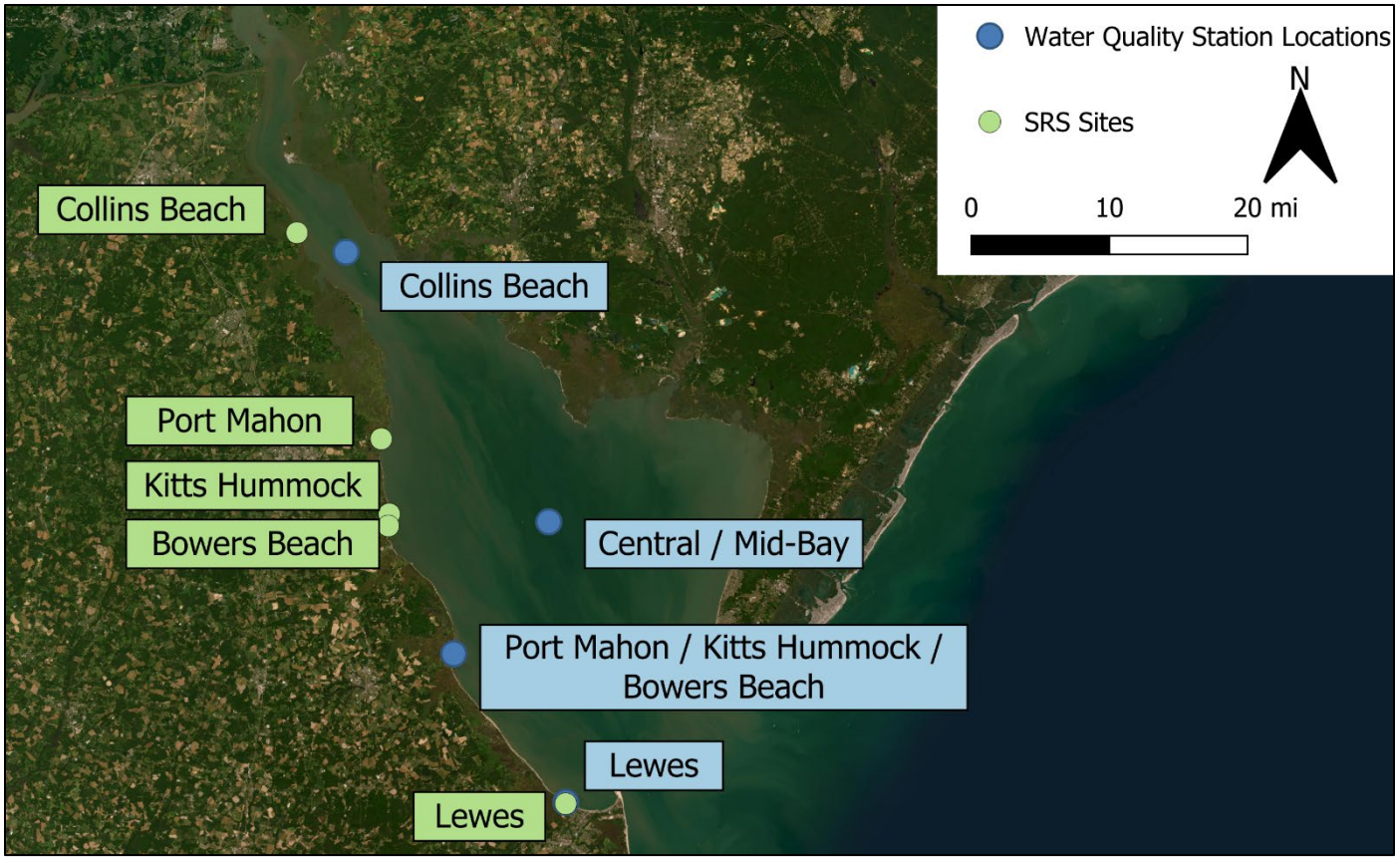
SRS
Site Locations



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SRS – Year 1
Methods and Metrics

- **Oyster Recruitment** (n = 6 bags/site)
  - Total spat count
  - Qualitative mortality

- **Water Quality**
  - Data mining from open-access water quality portals
    - Temperature
    - Salinity
    - Chlorophyll α
  - *In-situ* seasonal TSS analysis
    - 3 replicates per site


Bag deployments.


Seston sampling.


Spat counts.

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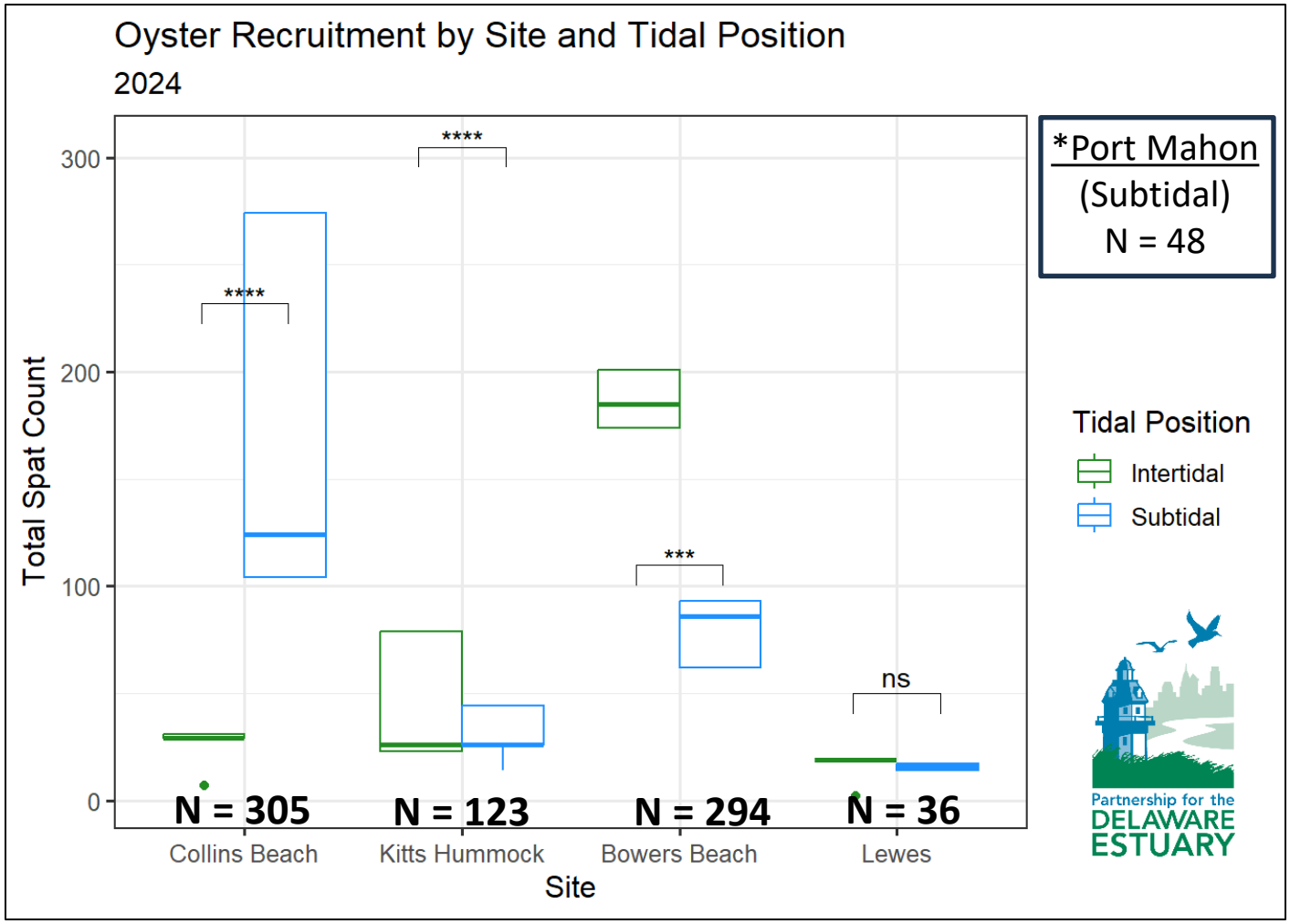
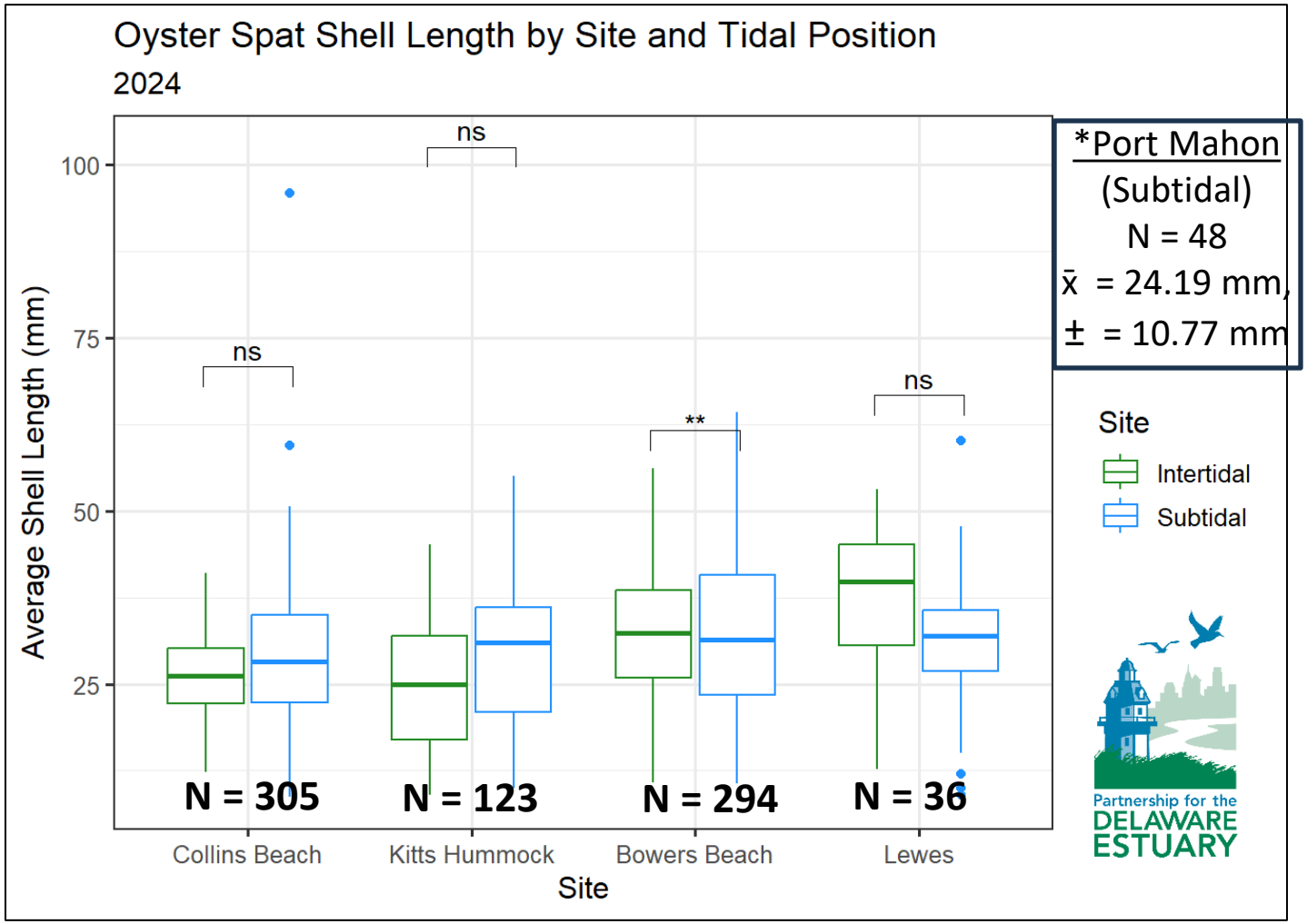
SRS – Year 1
Spat Counts by Tidal Position



SRS – Year 1
Spat Size by Tidal Position



Ranked Site Characterization for Oyster Population Development

x̄ = 9.3 ppt,
± = 3.3 ppt

Salinity

Collins Beach

3  |  1*

Port Mahon

4  |  4

Kitts Hummock

5  |  3*

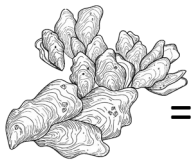
Bowers Beach

2*  |  2*

x̄ = 24.4 ppt,
± = 2.3 ppt

Lewes

1  |  5

 = Recruitment

 = Growth

* = Statistically significant

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Implications to Living Shoreline Planning in the Delaware Bay

- **Plastic Alternatives**
  - Commercially available alternatives are promising
  - Constantly improving technologies
  - Observed increased degradation in association with fouling/UV radiation

- **Shellfish Recruitment**
  - Consider substrate availability, predation pressure, sediment load, etc.
  - Recruitment rarely significantly varies by installation elevation
  - Low salinity as a disease refuge

SRS deployment of biopoly. material.

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Next Steps and Future Considerations

- Quantify recruitment mortality
- Continued annual recruitment sampling, including multi-year recruitment trend assessment
- Track recruitment to alternative vs. plastic material
- Trial newly available non-plastic materials
- Continue field installation observations and recirculating raceway experiment

SRS bag deployments at Bowers Beach, DE.

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Let's Collaborate

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Connecting people, science, and nature for a healthy Delaware River and Bay

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