Status of the Delaware Estuary Living Shoreline Initiative (DELSI)

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Erosion and accretion are natural processes that create dynamic habitats.

- Erosion = accretion = stability
- Erosion < accretion = marsh growth
- Erosion > accretion = marsh loss

**Challenge:**
In the face of sea level rise, how do we balance shoreline erosion and accretion to protect marsh habitats?
Common solutions:
- Bulkheads
- Riprap
- Revetments

Problem:
- Hard structures change ecological structure and function.

We can do better.
Shellfish as Natural Erosion Control

- Fringing oyster reefs absorb wave energy and trap sediments.
- Oyster reefs also create habitat, filter water, and recycle nutrients.
Ribbed mussels for living shorelines?

Ecological services
- Stabilize sediments
- Water filtration
- Nutrient cycling
- Sediment deposition

Not harvested
- No poaching concerns
- No human health risk

Synergism with grass forms natural marsh levees

Why not incorporate into existing living shoreline tactics?
DELSI Goal:

Develop living shoreline strategies for Delaware Bay that incorporate local shellfish communities.
DELSI Questions:

1) Can coir biologs and mats halt salt marsh erosion?

2) How can we use ribbed mussels to enhance the living shoreline?
Coir is a byproduct of the coconut industry

Husk fibers
Phase I

Test installation methods across a gradient of energy and erosion.
DELSI Deployment
Installed multiple configurations.

Total station surveys tied installations to local USGS benchmarks.

Established transects to monitor change.
Grass and mussels survived when planted in logs.

Initial monitoring provided exciting results.

Juvenile mussels recruited to coir logs.

... sediment trapping with rich mats of microphytobenthos.

... sweet success.
went sour after a few months.

Few logs remain at two sites.

Marsh retreat was evident.

Deflated logs = deflated enthusiasm
But the third site provided hope

Sediment accumulated behind most logs

Closing off ‘scallops’ worked best

...enthusiasm restored!
Energy and biolog survival

- Logs and mats survived best at low energy site
  - Logs did not work if tucked against marsh
  - Logs survived best when lined with oyster shell bags
DELSI Phase 1 Conclusions

Coir biolog treatments:
- attenuated waves
- reduced erosion
- trapped sediments
- produced microphytobenthos
- attracted mussels
- amenable to seeding

Optimal configuration:
- two rows of logs over mat with shell bags in front
Phase 2

Replicate successful installation method. Add grass and mussels. Quantify faunal use.
Seeding *Spartina*

Salvaged clumps

Nursery plugs
Apply Mussels
Four installations completed July 2010

Monitor:
Sediments
Grass
Fauna
Elevation is key
Motile Fauna

Seines:
deployed at high tide (in pairs)
retrieved at low tide

Minnow pots:
deployed at low tide (10 per trt/ctrl)
retrieved at low tide 24 hrs later
Seine Catch Data

Control: 20 species

Treatment: 17 species

### Seine Biomass

<table>
<thead>
<tr>
<th>Season</th>
<th>Control</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>1500</td>
<td>2000</td>
</tr>
<tr>
<td>Fall</td>
<td>2000</td>
<td>1500</td>
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<tr>
<td>Spring</td>
<td>1500</td>
<td>2000</td>
</tr>
<tr>
<td>All</td>
<td>1500</td>
<td>2000</td>
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</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Control</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>Grass Shrimp</td>
<td>1482</td>
<td>2080</td>
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<tr>
<td>Blue Crab</td>
<td>746</td>
<td>577</td>
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<tr>
<td>Bay Anchovy</td>
<td>323</td>
<td>39</td>
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<tr>
<td>Mummichog</td>
<td>235</td>
<td>245</td>
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<tr>
<td>White Perch</td>
<td>93</td>
<td>55</td>
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<tr>
<td>Silverside</td>
<td>51</td>
<td>39</td>
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<tr>
<td>Weakfish</td>
<td>16</td>
<td>15</td>
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<tr>
<td>Striped bass</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Black drum</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Windowpane flounder</td>
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<tr>
<td>Silver Perch</td>
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<td>26</td>
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<td>Hogchoker</td>
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<tr>
<td>American Eel</td>
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<td>2</td>
</tr>
<tr>
<td>Spot</td>
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<td>1</td>
</tr>
<tr>
<td>Unidentified</td>
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<td>1</td>
</tr>
<tr>
<td>Summer Flounder</td>
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<td>5</td>
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<tr>
<td>Common Carp</td>
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<tr>
<td>Atlantic Menhaden</td>
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<td>8</td>
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<tr>
<td>Naked Gobi</td>
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<td></td>
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<tr>
<td>Diamondback terrapin</td>
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<td>1</td>
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<tr>
<td>Toadfish</td>
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Minnow Pot Catch Data

Control: 8 species

Treatment: 9 species

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<thead>
<tr>
<th>Minnow Pot Species</th>
<th>Control</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>Grass Shrimp</td>
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<td>771</td>
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<tr>
<td>Mummichog</td>
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<td>1592</td>
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<td>Blue Crab</td>
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<td>Atlantic Menhaden</td>
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<td>White Perch</td>
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<td>10</td>
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<tr>
<td>Spotfin Mojarra</td>
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<td>2</td>
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<tr>
<td>Striped Bass</td>
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<tr>
<td>Silver Perch</td>
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<td>6</td>
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<tr>
<td>Diamondback Terrapin</td>
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<td>1</td>
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<tr>
<td>Bay Anchovy</td>
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Average Trap Biomass

- **Treatment**
- **Control**

<table>
<thead>
<tr>
<th>Season</th>
<th>Biomass (g)</th>
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<tbody>
<tr>
<td>Summer</td>
<td>600</td>
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<tr>
<td>Fall</td>
<td>200</td>
</tr>
<tr>
<td>Spring</td>
<td>200</td>
</tr>
<tr>
<td>All</td>
<td>400</td>
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Graph showing average trap biomass for different seasons and conditions.
DELSI Summary

- Biologs provide a novel tactic for Delaware Bay
- Trap sediments well
- Grass and mussel plantings survive
- Faunal use is similar to natural marsh

Next Steps

- Continue monitoring and assessment
- Develop mussel gardening
- Evaluate site potential throughout Delaware Bay
- Pursue new installations
Practitioner’s Guide available
September 2011 (after hurricane)
Thanks to our funding agencies and field crews!
Alternative mussel seeding methods