Great Bay Ecosystem Service Assessment

A scenario-based approach to understanding how key habitats affect the provision of ecosystem services and their value

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Background
19% population increase since 1990

120% increase in impervious cover since 1990

6.6 feet in possible SLR by 2100

38% eelgrass loss since 1990
GBESA: Goal

Better understand the ways people benefit from Great Bay estuary ecosystems and inform decisions to sustainably maximize those benefits while reducing conflict.
The Objectives

- Test an ecosystem services and economic valuation approach
- Spatial integrated assessment
- Outreach and communications materials
- Improve management and maximize ecosystem services
- Engage a variety of partner organizations
Great Bay ESA

Stakeholder Engagement

Outreach and Communication

Economic Valuation
Phase 1: Habitat Risk Assessment and Scenario Design
Habitats

- **eelgrass**
- **saltmarsh**
- **oyster beds**

Model Stressors

- **water pollution**
- **sea level rise**
- **invasives & disease**
- **physical/human uses**

Actions

- **assessment & planning**
- **conservation**
- **restoration**
- **pollution controls**

Services

- **carbon storage & sequestration**
- **flood protection**
- **recreation**
  - boating/nature viewing
  - shellfish harvesting
  - fishing
- **cultural & spiritual**
- **nutrient filtration & mixing**
- **commercial fisheries**
  - lobstering
  - Atlantic & diadromous fisheries
  - oyster aquaculture

Impact:

- Negative impact
- Positive impact
Gain and Sustain Habitats and Benefits

- Depicts eelgrass, oyster beds, and saltmarsh area in 2025 if conditions and management result in significant expansion of habitat and improvement in habitat function
- Water pollution is reduced
- Activities take into account existing and future habitats
- Armored shorelines on public and conservation lands removed
- Oyster restoration

Lose Habitats and Benefits

- Depicts eelgrass, oyster, and saltmarsh area in 2025 if conditions and management result in habitat loss
- Water pollution intensifies
- No active habitat restoration
- Shoreline armoring, docks, and mooring fields do not avoid existing habitats
- Activities intensify and do not consider existing or future habitat

Scenarios for 2025
Difference in Acres between Scenarios

- **Eelgrass**: 2866 acres
- **Saltmarsh**: 142 acres
- **Oyster beds**: 181 acres

- Moderately to highly vulnerable acres that are not present in "Lose Scenario"
Vulnerable and Resilient Eelgrass Areas in 2025

Key
- **Most Resilient Areas**: Eelgrass present in both scenarios (200 acres)
- **Most Vulnerable Areas**: Eelgrass lost in lose scenario (2,866 acres)
- **Active eelgrass restoration**: (111 acres of the 2,866)

Map produced for Great Bay Ecosystem Services Assessment by Kirsten Howard, NHDES Coastal Program, 10-2016
Vulnerable and Resilient Salt Marsh Areas in 2025

Key

Most Resilient Areas: Salt marsh present in both scenarios (2,004 acres)
- high marsh (1,275 acres)
- low marsh (729 acres)

Most Vulnerable Areas: Salt marsh lost in "Lose Scenario" (142 acres)
- high marsh (29 acres)
- low marsh (34 acres)
- active restoration marsh areas (59 acres high marsh, 20 acres low marsh)

Map produced for Great Bay Ecosystem Services Assessment by Kirsten Hewett, NHDES Coastal Program, 10-2016
Vulnerable and Resilient Natural Oyster Bed Areas and Hypothetical Oyster Aquaculture in 2025

Key

Natural and Restored Oyster Beds
- Most Resilient Areas: Oyster beds present in both scenarios (76 acres)
- Most Vulnerable Areas: Oyster beds lost in “Lose Scenario” (259 acres)
- Active Oyster Restoration (100 of the 259 acres)

Oyster Aquaculture
- New Areas Open to Harvest & Aquaculture in “Gain Scenario” (33 unsited acres permitted)
- Permitted Areas in Both Scenarios (83 acres)
- Permitted Areas in “Gain Scenario” that avoided eelgrass areas (23 acres)
- Permitted Areas in “Lose Scenario” that don’t avoid eelgrass areas (23 acres)

Map produced for Great Bay Ecosystem Services Assessment by Kirsten Howard, NHDES Coastal Program, 10-2016
Phase 2: Ecosystem Service Assessment
Phase 2: Overview

- Define ecosystem service priorities
- Develop valuation estimates
- Develop outreach materials
<table>
<thead>
<tr>
<th>Eelgrass</th>
<th>Salt Marshes</th>
<th>Oysters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrient control</td>
<td>Nutrient control</td>
<td>Nutrient control</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>Carbon sequestration</td>
<td>Commercial harvesting</td>
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<tr>
<td>Commercial fishing</td>
<td>Commercial fishing</td>
<td>Storm damage protection</td>
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<tr>
<td>Recreational fishing</td>
<td>Recreational fishing</td>
<td>Recreational harvesting</td>
</tr>
<tr>
<td>Storm Damage Protection</td>
<td>Storm Damage Protection</td>
<td></td>
</tr>
</tbody>
</table>
Economic value comes from difference in acres in 2025

- Scenario B (enhanced management)
- Scenario A (business as usual)
Valuation approach: benefit transfer

- Use values that were estimated in other areas
- Apply them to our situation
- Cost and time are usually driving factors
- There are principles and good practices to follow
## Summary of estimates

<table>
<thead>
<tr>
<th>Ecosystem Service</th>
<th>Habitat</th>
<th>Estimated Economic Value in 2025 (phrased in 2015 dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existence value</td>
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<tr>
<td><strong>Salt marshes</strong></td>
<td>$1.6 million</td>
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<tr>
<td><strong>Eelgrass</strong></td>
<td>$40.2 million</td>
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<tr>
<td><strong>Oyster beds</strong></td>
<td>$0.7 million</td>
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<tr>
<td>Recreational fishing</td>
<td><strong>All</strong></td>
<td>Variable; depends on turbidity and improvements in dissolved oxygen</td>
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<tr>
<td>Recreational oyster harvesting</td>
<td><strong>Oyster beds</strong></td>
<td>$23,700</td>
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<tr>
<td>Commercial aquaculture</td>
<td><strong>Oyster beds</strong></td>
<td>$131,200 - $142,100</td>
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<tr>
<td>Commercial fishing</td>
<td><strong>Salt marshes</strong></td>
<td>$4,473</td>
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<tr>
<td><strong>Eelgrass</strong></td>
<td>$1.7 million</td>
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<tr>
<td>Carbon sequestration</td>
<td><strong>Salt marshes</strong></td>
<td>$3,400 - $16,300</td>
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<tr>
<td><strong>Eelgrass</strong></td>
<td>$49,100 - $81,600</td>
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<tr>
<td><strong>Oyster beds</strong></td>
<td>$2,700</td>
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<tr>
<td>Nitrogen removal</td>
<td><strong>Salt marshes</strong></td>
<td>$608,300 - $688,800</td>
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<tr>
<td><strong>Eelgrass</strong></td>
<td>$13.1 million - $14.8 million</td>
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<tr>
<td><strong>Oyster beds</strong></td>
<td>$5.3 million - $6.0 million</td>
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</tbody>
</table>
Outreach Materials
People in New Hampshire will value improvement to Great Bay as a resource

**2013**

- **1,878 acres of eelgrass**
- **1,804 acres of salt marsh**
- **137 acres of oyster beds**

**Lose habitats and benefits**

- Shoreline erosion, docks, and mooring fields do not avoid existing habitats.
- Oyster aquaculture, recreational oyster harvesting, and recreational boat mooring areas do not consider locations of habitats.
- 2-3 inches of sea level rise with some salt marsh migration.

**Gain & sustain habitats and benefits**

- Water pollution vastly improves due to new regulations and programs that reduce point and non-point sources.
- Eelgrass recovers beyond 1994 levels due to reduced pollution.
- Significant eelgrass restoration efforts occur.
- Recreational boating intensifies, but clear marking in the Bay helps boaters avoid eelgrass beds.
- Moorings remain in the same places, but are changed to habitat friendly moorings.
- Anchored shad boats on public and conservation lands are removed along with other key fish restrictions.
- Recreational shellfish beds recover to 1990s levels as a result of better management and increased spot fishing.

- **200 acres of eelgrass**
- **2,003 acres of salt marsh**
- **78 acres of oyster beds**
- **3,066 acres of eelgrass**
- **2,146 acres of salt marsh**
- **259 acres of oyster beds**

Studies have shown that households are willing to pay for the existence of habitats such as eelgrass, salt marshes, and oyster beds. The value that people place on these habitats come from the fact that people can use them for recreation or simply enjoy them, but also because people just like to know those habitats are there. Using the estimates from these past studies, NH DES and NOAA estimated that households in the Piscataqua watershed would be willing to pay more than **$42 million annually** for the increased amounts of eelgrass, salt marsh, and oyster beds that will come from improved management.
The Future of the Great Bay Estuary

Now vs 10 years from now

Gain & Sustain Habitats and Benefits
- active restoration and planning;
- less water pollution;
- some shoreline armoring removed;
- new oyster harvest areas;
- boating activity, new moorings and new oyster aquaculture avoid existing and historical eelgrass areas

The existence of this is worth $42 million more than

Lose Habitats and Benefits
- no active restoration and limited planning;
- more water pollution;
- more shoreline armoring and docks;
- new moorings, new oyster aquaculture, and recreational boating overlap historical eelgrass areas
Economic value of increased commercial fishing catch in the Gulf of Maine from improved management of Great Bay

Estuaries that contribute to commercial fishing in the Gulf of Maine

Great Bay
Edgrass offers nursery habitat for commercial fish, as well as a place for commercial fish to find food.

2,800 acres of edgrass that come from better management in the future

$1.7 million in annual revenues benefitting commercial fishermen in New Hampshire, Maine, Massachusetts and other areas that fish in the Gulf of Maine
Next steps
Lessons learned

• Understand the decision context and the policy window
• Focus on results that are useful to stakeholders
• Pull in expertise as needed.
• Use frequent feedback loops with stakeholders.
• Work with stakeholders to define priorities.
• Educate the stakeholders throughout the process.
• Be mindful of stakeholder time commitments.
• Give time for stakeholders to understand and gain comfort with key project components.
• Develop outreach with stakeholder needs in mind.
• Invite someone from another NERR or another area to participate in the project as an observer.
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