Effects of Nitrogen Loading on Greenhouse Gas Emissions from Salt Marshes

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- James Rassman, Chris Weidman, Omar Abdul-Aziz,
- Jessie Gunnard, Zhunqiao Liu, Hualei Yang, Aizhen Liang, Xuechu Chen
Objectives

• Quantify C sinks in salt marshes.
• Quantify GHG (CO$_2$, CH$_4$, N$_2$O) fluxes, both vertically and laterally.
• Assess the impact of anthropogenic N loading and restoration of salt marsh on both C sequestration and net GHG emissions.
Conceptual framework

A. Vertical fluxes (CO₂) and lateral fluxes (DOC, DIC, POC, DON, DIN, PON; CO₂, N₂O, CH₄)

B. Anthropogenic N loads and higher temperatures

Lateral fluxes (DOC, DIC, POC, DON, DIN, PON; CO₂, N₂O, CH₄) and rising sea level
Vertical GHG Flux Measurement Locations

○ = Marsh zone comparison (Serena)

○ = Nitrogen site comparison (Jim T.)
Methods to measure blue carbon

1. Flux – understand the mechanism and process

Net ecosystem C balance (NECB)

\[ \text{NECB} = \text{NEP} - \text{RCH}_4 - \text{FL}. \]

- **NEP**: net ecosystem production
- **RCH\textsubscript{4}**: CH\textsubscript{4} flux measured simultaneously with NEP.
- **FL**: net lateral flux

2. Stock/pool: Long-term soil/sediment carbon stocks and their changes
In-situ GHG flux measurement
Preliminary results: \textbf{CO}_2 \text{ fluxes: Daytime uptake and nighttime emissions}
CH$_4$ fluxes

![CH$_4$ flux graph showing data for 2012 and 2013 for Eel Pond, Great Pond, Hamblin Pond, and Sage Lot Pond.](image)
$\text{N}_2\text{O}$ fluxes

N loading: 1-10 gN/m$^2$/y
$\text{NO}_3^-$ and $\text{NH}_4^+$ concentration in porewater

**NO}_3^-$

<table>
<thead>
<tr>
<th>Location</th>
<th>Jul-13</th>
<th>Dec-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eel</td>
<td>1.50</td>
<td>1.00</td>
</tr>
<tr>
<td>Great</td>
<td>2.00</td>
<td>1.50</td>
</tr>
<tr>
<td>Hamblin</td>
<td>1.20</td>
<td>0.80</td>
</tr>
<tr>
<td>Sage Lot</td>
<td>1.00</td>
<td>0.50</td>
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**NH}_4^+

<table>
<thead>
<tr>
<th>Site</th>
<th>Concentration, umol/L</th>
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<tbody>
<tr>
<td>EP</td>
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<tr>
<td>GP</td>
<td>100</td>
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<tr>
<td>HP</td>
<td>40</td>
</tr>
<tr>
<td>SL-LM</td>
<td>30</td>
</tr>
<tr>
<td>SL-HM</td>
<td>10</td>
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</tbody>
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Aboveground biomass

![Bar graph showing total live biomass (g/m²) for different months and sites.]
Root and Rhizome biomass

- **Eel Pond (N = 4)**
- **Hamblin Pond (N = 4)**
- **Sage Lot Pond (N = 9)**
- **Great Pond (N = 3)**
Short-term N addition experiment: N$_2$O fluxes responding to 1.4 gN/m$^2$

Adding time: 11:50-11:55 am

High tide started

Marsh platform was flooded
Effects of salt marsh restoration on greenhouse gas emissions
Does the CH$_4$-sality curve hold during the restoration process?

Poffenbarger et al. 2011
Preliminary conclusions

• Considering CO$_2$, CH$_4$, and N$_2$O fluxes combined, the salt marsh is a significant carbon sink.

• Large amounts of N loading could lead to N$_2$O emissions in salt marshes.

• Salinity increases could result in CH$_4$ decreases – need to quantify this in the field.