Benefits and challenges of continuous flow and nitrogen monitoring in a restored salt marsh in North Carolina

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Site Location

Restoration Goals

• Improve water quality in the North River
• Restore habitat
• Provide design guidance for future salt marsh projects in coastal North Carolina
Research Questions

• Can continuous monitoring be used to quantify the ability of a restored salt marsh to retain excess nutrients?
• Are there seasonal, daily, or tidal trends in nutrient release or retention?
• Is there a relationship between nutrient retention or release and the type of organic matter present in the stream?
Research Questions

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Research Objectives

• Quantify the ability of a restored salt marsh to dissipate excess nutrients
• Quantify the timing and kinetics of nutrient dissipation and/or release
• Correlate the dissipation and/or release of nutrients to the type of organic matter

Methods

Continuous nutrient mass balance between inlet and outlet

Flow Monitoring in a Tidal Stream

• Cannot use normal rating curve due to bi-directional flow
• Flumes serve as a constant cross section – cross section area measurement creates the most error in flow monitoring
Flow Calculations

\[ Q = V \times A \]

- \( Q \): flow
- \( V \): velocity
- \( A \): cross-section area

Continuous Flow Monitoring

- Doppler velocity meter records velocity and water depth in flume
- Average velocity and water depth recorded every 15 minutes
- Use manual stream gaging to relate Doppler velocity to actual flow in the flume

Manual Stream Gaging

Flow Calibration

\[ y = 1.0738x \]

\[ R^2 = 0.9792 \]

Flow Monitoring in a Tidal Stream

- One challenge presented in the marsh: high tide or water level above the flumes
- Solution: direct flow through the flume using impermeable fence
Continuous Water Quality Monitoring

- Monitored using UV-visual spectrophotometer placed in the stream
- Absorption spectrum and parameters measured every 15 minutes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum</th>
<th>Resolution</th>
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<tbody>
<tr>
<td>NO₃⁻N</td>
<td>70 mg/L</td>
<td>0.1 ±mg/L</td>
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<tr>
<td>TOC</td>
<td>150 mg/L</td>
<td>0.2 ±mg/L</td>
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<tr>
<td>DOC</td>
<td>90 mg/L</td>
<td>0.2 ±mg/L</td>
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<tr>
<td>Turbidity</td>
<td>1400 FTU</td>
<td>1.3 FTU</td>
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</tbody>
</table>

Absorption Spectra

- High NO₃⁻N
- Low NO₃⁻N
The Problem
Nitrate Concentration and Flow

Flow (m^3/s)

NO₃-N (mg/L)

Field Visit

Nitrate Concentration and Flow

Absorption Spectra

Before Cleaning

After Cleaning

Absorbance Coefficient (m⁻¹)

Wavelength (nm)

Absorption Spectra

Before Cleaning

After Cleaning

Fouling

After Installation

Two Weeks Later
Challenges of Continuous Water Quality Monitoring

- Preventing/reducing window fouling
- Calibration
- Solar power

What We Hope to Accomplish

- Calculate the amount of nitrate entering or leaving the marsh every 15 minutes
- Use a long-term mass balance to determine the mass of nitrate being retained or released by the marsh
- Minimize sources of error

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  - Nicole Cormier
  - Rebecca Moss
Other Research

- Continuously monitor:
  - DOC
  - pH
  - Conductivity/Salinity
  - Dissolved Oxygen
  - DOM Fluorescence
- Gas fluxes
- Stream stage using machine vision and web cams