Intensive monitoring to develop a water and nitrogen balance for a constructed tidal stream

J. Randall Etheridge, François Birgand, Michael R. Burchell II

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 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
- Qualify nature of organic matter using fluorescence measurements

Upstream/Downstream Monitoring

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

Flow Calibration

\[ y = 0.9889x \]
\[ R^2 = 0.9856 \]

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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</thead>
<tbody>
<tr>
<td>NO$_3$N</td>
<td>70 mg/L</td>
<td>0.1 ±mg/L</td>
</tr>
<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>
</tr>
</tbody>
</table>

**Absorption Spectra**

- High NO$_3$-N
- Low NO$_3$-N
The Problem
Nitrate Concentration and Flow

Absorption Spectra

Absorbance Coefficient (m$^{-1}$)

Wavelength (nm)

Before Cleaning

After Cleaning

After Installation

Fouling

Two Weeks Later
Take Measurement

Water Tank

Compressed Air

Stream

Clean

Challenges of Continuous Water Quality Monitoring

• Calibration
• Preventing/reducing window fouling
• Solar power

Future Research

• Continuously monitor:
  – DOC
  – pH
  – Conductivity/Salinity
  – Dissolved Oxygen
  – DOM Fluorescence
• Gas fluxes

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