Examining sources of sediment carbon stored in seagrass habitats across the Skagit Delta and Padilla Bay

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The Salish Carbon Blues

Examining sources of sediment carbon stored in seagrass habitats across the Skagit Delta and Padilla Bay

Erin Murray
April 5, 2018
What is Blue Carbon?

280 metric tons C/hectare
250 metric tons C/hectare
140 metric tons C/hectare

(x 28) (x 25) (x 14)
Why study Blue Carbon?

- Carbon Financing
- Calculating Carbon Emissions from Land Use Change
- Coastal Management Plans
How seagrasses trap carbon

- Biomass
- Slow decomposition of detritus
- Low Oxygen
- Reduce water flow
- Increase deposition
- Reduce re-suspension
- Slow decomposition of detritus

**BIOTIC**

**ABIOTIC**
Questions:

- Is the ecosystem service of carbon storage in Puget Sound robust enough to be included in coastal management plans or carbon budgets?
- Does carbon storage differ between a natural estuary to a diked shoreline?
- If there is carbon storage in these habitats, where is it coming from?
Geomorphic Variability:

Skagit River (active delta)

Padilla Bay (diked and drained in 1900s)
Sample Design

Vegetated
3 Cores

Bare
3 Cores

N = 12 Cores

Site

0 - 20cm
Subsample every 2cm

20 - 50cm
Subsample every 5cm

50cm - end
Subsample every 10cm

N = 217 Subsamples
Lab Analyses

1. How much Carbon is there?
   Total Carbon and Nitrogen Elemental Analysis

2. Where is the Carbon from?
   Stable Isotopes $^{13}$C & $^{15}$N

3. How dense is the sediment?
   Bulk Density

4. Is the sediment muddy or sandy?
   Grain Size Analysis
Statistical Analyses

Whether a core was located in a delta or inactive delta or vegetated or bare site is influential for total carbon stock?
  ▪ 2 Way ANOVA

What variables had more of an effect on total carbon and where it came from?
  ▪ Linear Mixed Effects Models
    ▪ **Response Variable:** Carbon/N15/C13
    ▪ **Fixed Factors:** Delta, Vegetated, Top 20 cm, and % Fine Sediment

Where is the stored carbon coming from?
  ▪ MixSIAR model
# Results: Total Carbon Stock

<table>
<thead>
<tr>
<th>Skagit Veg Cores</th>
<th>Observed at 50cm metric tons C/ha</th>
<th>Extrapolated to 1 meter metric tons C/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16.82</td>
<td>33.64</td>
</tr>
<tr>
<td>2</td>
<td>45.63</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>27.96</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Skagit Bare Cores</th>
<th>Observed at 50cm metric tons C/ha</th>
<th>Extrapolated to 1 meter metric tons C/ha</th>
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<tbody>
<tr>
<td>1</td>
<td>16.17</td>
<td>32.35</td>
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<tr>
<td>2</td>
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<td>14.17</td>
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<tr>
<td>1</td>
<td>25.64</td>
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</table>

<table>
<thead>
<tr>
<th>Padilla Cores</th>
<th>Observed at 50cm metric tons C/ha</th>
<th>Extrapolated to 1 meter metric tons C/ha</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>15.92</td>
<td>31.88</td>
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<tr>
<td>2</td>
<td>15.46</td>
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<td>3</td>
<td>19.09</td>
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</table>

<table>
<thead>
<tr>
<th>Average</th>
<th>Observed at 50cm metric tons C/ha</th>
<th>Extrapolated to 1 meter metric tons C/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.15</td>
<td></td>
<td>34.29</td>
</tr>
</tbody>
</table>
Results: Carbon Density

- No detectable difference between Skagit & Padilla
- No detectable difference between Vegetated & Bare

Fine Grained Sediment was the most explanatory factor
Results: Fine Grained Sediment & Carbon Density
Results: Stable Isotopes

Heavy Isotope = \( \frac{(R_{\text{sample}} - R_{\text{standard}})}{R_{\text{standard}}} \times 1000 \)

R is the ratio between \(^{14}\text{C}:^{13}\text{C}\) or \(^{15}\text{N}:^{14}\text{N}\):
13C Isotope Results

- Significant difference between Skagit & Padilla
- Significant difference between Vegetated & Bare habitat in Skagit and Padilla

Fine Grained Sediment was the most explanatory factor
Summary of Results

Is the eelgrass ecosystem service of carbon sequestration in the Salish Sea robust enough to be included in coastal management plans or carbon budgets?

Not really

Does carbon stock differ between a natural estuary to a diked shoreline?

Not really

If there is carbon storage in these habitats, what is its source?

Digging into this further, but so far does not look like it is coming from seagrass.
Acknowledgements

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Questions?