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
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UNIVERSITY of WASHINGTON
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

Sediment

Slow decomposition of detritus

Low Oxygen

BIOTIC

Reduce deposition

Reduce re-suspension

Sediment

ABBIOTIC

Reduce water flow
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?
Geomorphologic Variability:

Skagit River (active delta)

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

Site

Vegetated 3 Cores
Bare 3 Cores

N = 12 Cores

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

- **Skagit Veg Cores**:
  - Observed at 50cm:
    - 1: 16.82 metric tons C/ha
    - 2: 16.17 metric tons C/ha
  - Extrapolated to 1 meter:
    - 1: 33.64 metric tons C/ha
    - 2: 32.35 metric tons C/ha

- **Skagit Bare Cores**:
  - 1: 16.17 metric tons C/ha
  - 2: 7.09 metric tons C/ha
  - Extrapolated to 1 meter:
    - 1: 32.35 metric tons C/ha
    - 2: 14.17 metric tons C/ha

- **Padilla Cores**:
  - 1: 15.92 metric tons C/ha
  - 2: 15.46 metric tons C/ha
  - 3: 19.09 metric tons C/ha
  - Extrapolated to 1 meter:
    - 1: 31.82 metric tons C/ha
    - 2: 30.94 metric tons C/ha
    - 3: 65.89 metric tons C/ha

**Average**:
- Observed at 50cm: 17.15 metric tons C/ha
- Extrapolated to 1 meter: 34.29 metric tons C/ha

**Total Carbon Stock**: 140 metric tons C/ha
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 \(^{15}\text{N}:^{14}\text{N}\):
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 its source?

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

http://www.padillabay.gov/brant/sites/padilla.html
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Questions?