Apr 30th, 3:30 PM - 5:00 PM

Three birds with one stone: Tidal wetland restoration, carbon sequestration, and enhancing resilience to rising sea levels in the Snohomish River Estuary, Washington

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Speaker
John Rybczyk, Steve Crooks, Danielle Devier, Steve Emmett Mattox, Nathan Moore, Keeley O'Connell, Katrina Poppe, and Nelson Salisbury

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Three birds with one stone:

Tidal wetland restoration,
carbon sequestration,
and enhancing resilience to rising sea levels
in the Snohomish River Estuary, Washington

John Rybczyk¹, Steve Crooks⁴, Danielle Devier⁴, Steve Emmett-Mattox², Nathan Moore¹, Keeley O'Connell³, Katrina Poppe¹, Nelson Sallsbury³

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2. Restore America's Estuaries, Arlington, VA, United States.
3. Earth Corps, Seattle, WA, United States.
Pre-Settlement (1861)

- 4000 ha of tidal wetlands
- Mix of mudflats, emergent marsh, emergent scrub/shrub and forested wetlands.
Current Conditions

- Only 16% of estuarine wetland remain.
- Industrial infrastructure, 2 landfills, 2 sewage treatment plants, I-5.
- 71 kilometers of dikes and associated drainage for agriculture.
- Restricted sediment delivery and shallow subsidence.
Estuaries at Risk

- Rising Sea Levels
- Sediment Deficits
- Subsidence

?
A Multi-Agency Restoration Effort: Levee Removal/Breaching

- Restore Estuarine Habitat
- Keep Pace with SLR
- Enhance Carbon Storage
- Fund Restoration Efforts
A Multi-Agency Restoration Effort: Levee Removal/Breaching

Quantify sedimentation rates, carbon storage, and carbon accumulation rates in the estuary.
3 “Natural” Sites
RESTORED AREAS

North Ebey (NE), Photo Courtesy of Earth Corps.

Union Slough (US), Photo Courtesy of Earth Corps.

Spencer Island (SP), Photo Courtesy of Earth Corps.

Smith Island South (SS), Photo Courtesy of Earth Corps.

Marysville (MA), Photo Courtesy of Earth Corps.
4 Potential Restoration Sites
POTENTIAL RESTORATION AREAS

Qwuloolt (QW), Photo Courtesy of Earth Corps.

WDFW Forest (WF), Photo Courtesy of Earth Corps.

Smith Island North (SN), Photo Courtesy of Earth Corps.

WDFW Wetland (WW), Photo Courtesy of Earth Corps.
Field Methods

- 2 cores
- RTK Elevation
- Pore water salinity
- Rapid Veg. Assessment
Laboratory Methods

- Cores sliced into 2cm sections
- Bulk Density
- LOI % O.M. and Mineral Matter by Weight
- Carbon by CHN analyzer
- $^{210}$Pb
By Calculation

- Sediment core profiles
- Mean carbon densities in top 30 cm
- Sediment accretion rates
- Carbon accumulation rates
Results

The diagram illustrates the elevation (m, NAVD88) at various sites categorized into three groups: Natural Areas, Transition Areas, and Possible Restoration Areas. The sites include Quilceda Marsh, Heron Point, Otter Island, Union Slough, Marysville, North Ebey, Smith Island (City), Spencer Island, Qwuloolt, Smith Island (County), WDFW Wetland, and WDFW Forested. The elevations range from MLLW to MHHW, with MLLW being the mean lower low water and MHHW being the mean higher high water.
Quilceda Marsh (Natural Condition Site)

- Estuarine Emergent
- *Carex lyngbyei*
- Salinity = 8 ppt
Quilceda Marsh (Natural Condition Site)
Mean Carbon Density in the Upper 30 cm

- Natural Sites
- Transitional Sites
- Potential Restoration Sites

Sites: Quilceda, Heron, Otter, Union Slough, Marysville, North Ebey, Smith City, Spencer, Qwuloot, Smith County, WDFW W, WDFW F
<table>
<thead>
<tr>
<th>Site</th>
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<td>0.12</td>
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WDFW (Potential Restoration Site)

• Diked and drained in the early 1900’s, later abandoned
• *Phalaris arundinacea*.  
  *Agrostis* sp.
• Salinity = 6 ppt
WDFD: Unrestored Former Ag. Land.
Mean Carbon Density in the Upper 30 cm

- **Natural Sites**
- **Transitional Sites**
- **Potential Restoration Sites**

G C cm⁻³

- Quilceda
- Heron
- Otter
- Union Slough
- Marysville
- North Ebey
- Smith City
- Spencer
- Qwuloot
- Smith County
- WDFW W
- WDFW F

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North Ebey (Restored Site)

- Breached between 1965 and 1970
- Soft Stemmed Bulrush, *Typha* sp.
- Salinity = 1 ppt
North Ebey: Restored Marsh
Mean Carbon Density in the Upper 30 cm

- Natural Sites
- Transitional Sites
- Potential Restoration Sites
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Conclusions

• All of the formerly diked, or still diked sites revealed evidence of subsidence.
• Natural sites were accreting at a rate equal to or exceeding the rate ESLR.
• Carbon storage in the natural sites were within the range reported for other sites on the west coast.
• High carbon density does not necessarily mean high carbon accumulation rates.
• Breached sites show great potential for successful restoration, high rates of carbon storage, and resilience to rising sea levels.
Objectives
Rates of sediment accretion, carbon accumulation, and mineral accumulation for the three natural sites. Accretion rates were determined from the distribution of excess $^{210}\text{Pb}$ activity with depth using one core from each site. Carbon and mineral accumulation rates were calculated from the accretion rates and the average carbon or mineral density within the top 30 cm.

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(Grossman and Fuller In Prep.)
Union Slough (Restored Mudflat)
Rates of sediment accretion, carbon accumulation, and mineral accumulation for five sites + the North Ebey Restoration Site.

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