Assessment of nutrient, metal, and organic contaminant concentrations in eelgrass (Zostera marina L.) in Puget Sound, WA (USA)

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Assessment of nutrient, metal, and organic contaminant concentrations in eelgrass (*Zostera marina* L.) in Puget Sound, WA

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Nearshore Habitat Program
Washington State Department of Natural Resources

Salish Sea Ecosystem Conference
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• DNR manages land and resources throughout the state

• Eelgrass is an embedded resource that has important ecosystem values
Toxicity Pathways in Seagrass Meadows

CONTAMINANT TROPHIC TRANSFER (GRAZING)
- Planktonic Herbivores
- Epibenthic Meio-Macrofauna
- Infaunal Meio-Macrofauna

DRIFT and EXPORT
MODIFYING FACTORS
- Temperature
- Irradiance
- Nutrients
- Salinity

CONTAMINANT TOXICITY and BIOACCUMULATION (Blades, Epiphytes, and Grazers)

MODIFYING FACTORS
- Dissolved Oxygen
- Sulphide Concentrations
- Total Organic Carbon

SEDIMENT TOXICITY and CONTAMINANT BIOACCUMULATION (Rhizome, Roots, Epibenthic and Infaunal Species)

Lewis & Devereux 2009
Trace elements and oil related contaminants (1988)

- Document background levels in sediment, bivalves and eelgrass in the event of an oil spill

- Higher PAH levels in eelgrass were observed at sites closest to the oil refinery infrastructure
  - PAHs: 0.05 – 0.17 µg gww⁻¹

- Higher arsenic levels associated with the March Point Landfill
  - Arsenic: 2-8 µg gdw⁻¹
Project Objectives

• Baseline assessment of nutrients, metals, and organic contaminants in eelgrass (Zostera marina) throughout Puget Sound
  – Spatial distribution
  – Proximity to outfalls
  – Co-locate with Mussel Watch sites
Site Selection

- Spatially distributed
- Impacted and pristine areas
- Access (safety at night)
- Permission
- Assistance
- Co-location with other research
  - eelgrass (USFW 1994)
  - mussels (Lanksbury et al. 2012)
Methods

- %C, %N, $\delta^{13}$C, $\delta^{15}$N
- As, Cd, Cr, Cu, Fe, Pb, Hg, Ni, V, Zn,
- PAHs, PCBs, PBDE, DDT
%N = 4% (1-5%)
%C = 37% (28-43%)

Relatively low C:N ratios (< 20, median for global seagrass) suggest high nutrient availability
**Arsenic**

- highest in aboveground biomass at Padilla Bay
- highest in belowground biomass at Thompson Spit
Copper

• highest in above- and belowground biomass at 4-Mile Rock
Nickel

- highest in above- and belowground biomass Cypress Island
• highest PAHs measured in the aboveground biomass at 4-Mile Rock.
PCBs and PBDEs

Total PCBs

- Concentration (ng gww⁻¹ ±SE)
- Aboveground
- Belowground

Total PBDEs

- Concentration (ng gww⁻¹ ±SE)
- Aboveground
- Belowground

LIPIDS

- Concentration (%)
- Aboveground
- Belowground

Locations:
- Birch Bay
- Post Point
- Cypress Island
- March Point
- Paullina Bay
- Penn Cove
- Thompson Spur
- Big Guich
- 4 Miles Rock
- Downeath Head
- Holly
- Buried Spit
- Dumas Bay
- Ruscon Way
- Sandy Bay

Map:
- Seattle
- Tacoma

Source: Washington State Department of Natural Resources
www.dnr.wa.gov
• Research threshold effect of concentrations under environmental conditions similar to Puget Sound
  – evidence that concentrations of certain metals affect physiological process
  – mesocosm study
  – field component along a gradient

• Explore the potential of nutrient, metal, and organic contaminant cycling (aboveground tissue) and storage (belowground tissue)
Partners and Volunteers

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Laboratories
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- Katherine Bourbonais (KCEL)
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- Ben Harlow (WSU)

Site Contacts and Assistance
- Puget Sound Corps (WCC team, Birch Bay, Cypress Island, Anderson Island)
- Port of Orcas Island Airport (Orcas Island)
- FHL, Pema Kitaeff and divers (Orcas Island)
- Padilla Bay NERR (D. Bulthuis & H. Bohlmann, Padilla Bay)
- Megan Black (Thompson Spit)
- Al Bahl (Big Gulch Wastewater Treatment Facility, Big Gulch)
- Lincoln Lohr (Big Gulch)
- Seattle Parks and Recreation (Barbara DeCaro, 4-Mile Rock)
- Arlene Bac and Holly White (Holly)
- Cathy Short (Holly)
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