ENVVEST Mussel Watch Project: Monitoring Environmental Quality in Local Waters
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Puget Sound Naval Shipyard & IMF Project ENVironmental inVESTment (ENVVEST)

ENVVEST Mussel Watch Project

Outline of Talk

Introduction
Background
Overview of ENVVEST Studies
Mussel Watch Sampling
2010 - 2016 Results
Comparison to Benchmarks
Summary and Conclusions
Puget Sound Naval Shipyard & IMF (PSNS&IMF)
Project ENVVEST
- Final Project Agreement (Sep. 2000)
  PSNS&IMF/EPA/Ecology
- Cooperative technical studies with local agencies and stakeholders for watershed monitoring and modeling
- Pool resources to solve environmental problems

Pay off – Goodwill from regulatory agencies, stakeholders and public, and real improvements in environmental quality

Major Accomplishments
- Developed model of watershed and Inlets
- Assessed contaminant loading from storm events and runoff
- Contributed to reopening of 1500 acres of shellfish beds in Dyes Inlet
- Technical Support for FC TMDL
- Providing science to inform NPDES permitting process
Two Main Sources of Impact

- Historical releases of pollutants
  - Past practices (Point Sources)
  - Legacy residual contamination
- Watershed Development
  - Loss of natural habitat
  - Increases in runoff from landscape
  - More Nonpoint Source Pollution
ENVVEST Mussel Watch Sampling

Partnering with WDFW and Local Stakeholders
Coordinated with National Mussel Watch Program
Representative Sampling Site Locations
– 3 Stations/Site, Size Distribution
– Composite Sample for Chemistry
  • Metals, PAHs, PCBs
  • $\delta^{13}C$, $\delta^{15}N$, and Lipids

Participating Jurisdictions
City of Bremerton Parks & Rec
City of Bainbridge Island
Port of Bremerton
Port of Browsville
Port of Illahee
Port of Poulsbo
Port of Silverdale
Private Landowner
Suquamish Tribe
US EPA/NOAA Manchester Lab
US Navy Naval Base Kitsap (NBK)
US Navy Naval Undersea Warfare Center
US Navy Puget Sound Naval Shipyard & IMF
Washington Department of Fish and Wildlife
Washington State Parks Illahee
DYOTS – Dyes Inlet Old Town Silverdale
Port of Silverdale

POPBWN – Port Orchard Passage Brownsville
Port of Brownsville
Mussel Watch Sampling

2016 Mussel Watch Sampling Port of Illahee
Photo by Jim Aho
Winter Sampling Nov - Feb

Sum of average daily rainfall reported from Kitsap County rain gauges (CoCoRaHS 2016)

ENVVEST Mussel Watch 2010 and 2012 Data Evaluation

- Possible Trend
  > 3x difference between years
- Possible Source
  > 3x higher than other stations
- Possible Ecological Effect – Critical Body Residue
- Comparison to Seafood Market Sample
- Comparison to National Data Set
  – Low, Medium, and High Ranges
**Hg - Mercury**

<table>
<thead>
<tr>
<th>Critical Body Residue</th>
<th>National MW Range ppm dry weight</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hg</td>
</tr>
<tr>
<td>Low</td>
<td>0.00 - 0.17</td>
</tr>
<tr>
<td>Medium</td>
<td>0.18 - 0.35</td>
</tr>
<tr>
<td>High</td>
<td>0.36 - 1.28</td>
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Seafood Market (Penn Cove, Whidbey Island)

**Cu - Copper**

<table>
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<tr>
<th>National MW Range ppm dry weight</th>
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<tbody>
<tr>
<td>Cu</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
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**Total PCBs – Polychlorinated Biphenyls**

- **Sinclair Inlet**
- **NBK-Bremerton**
- **Dyes I.**
- **Passages/Liberty Bay**

<table>
<thead>
<tr>
<th>PCBs</th>
<th>Low</th>
<th>0.4 - 21.3</th>
<th>Medium</th>
<th>21.5 - 66.6</th>
<th>High</th>
<th>66.8 - 197</th>
</tr>
</thead>
</table>

**National MW Range**
- ppb wet weight
- PCBs

**Sum PAHs – Polycyclic Aromatic Hydrocarbons**

- **Sinclair Inlet**
- **NBK-Bremerton**
- **Dyes I.**
- **Passages/Liberty Bay**

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Low</th>
<th>9 - 165</th>
<th>Medium</th>
<th>166 - 618</th>
<th>High</th>
<th>618 - 1054</th>
</tr>
</thead>
</table>

**National MW Range**
- ppb wet weight
- PAHs

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1/30/2017
Conclusions

- Monitoring Program is focused on tracking environmental quality in the Inlets
  - Can identify problems for further investigation and correction
  - Can be used to evaluate effectiveness of corrective actions
- What are the Biota Telling Us?
  - Some Areas were elevated with PAHs, PCBs, and metals
  - 3 of 24 sites had increased risk of ecological effects
  - Contaminants of concern were PAHs (3 sites), PCBs (2 sites), Hg (1 site), and Cu (1 site)
- Overall decrease in contaminant levels indicates Improving Environmental Quality
- Monitoring framework provides context for interpretation
  - Better information = better management
References:


Current Work: Incorporate Passive Samplers into Stormwater Monitoring Program
Passive Samplers and Chemicals of Concern

• Diffusive Gradient in Thin film (DGT) Metals
  – DGT Metals (Cd Cr Cu Ni Pb Zn)

• Polar Organic Chemical Integrative Sampler (POCIS)
  – Human Activity (Wastewater) Markers
    • Caffeine
    • Nicotine
    • Sweeteners
    • Medicines
    • Herbicides
    • Flame Retardants

Summer-Fall 2016 and Winter 2017 Sampling Locations

Station Location
WWTP Outfall
Stormwater Passive Sampling

Objectives:
1. Work with stakeholders to integrate passive sampling into existing stormwater monitoring.
2. Validate the use of passive sampling devices to capture pulse inputs from stormwater runoff and better identify sources.
3. Optimize stormwater sampling designs to obtain better information with lower costs.
4. Gain regulatory and public acceptance of technical approach.