Characterizing changes in Puget Sound benthic infaunal invertebrate assemblages: A functional approach

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Characterizing Changes in Puget Sound Benthic Infaunal Invertebrate Assemblages: A Functional Approach

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Salish Sea Ecosystem Conference
April-May 2014
Spatial Monitoring

• Baseline 1997-2003
• 2nd Round 2004-2014
• 10-yr regional and 6-yr urban bay rotation
• Probabilistic, random stratified design
• Sediment Quality Triad = Chemistry, Toxicity, Benthos
Changes in Regions and Bays

- **Chemistry**: No change or slight improvement
- **Toxicity**: Increase in low-level toxicity
- **Benthos**: Increase in adversely affected

**Triad**: Deterioration in overall sediment quality, driven primarily by benthos
Declines in Abundance, Richness

Percent Change in Median

Total Abundance

-60% -50% -40% -30% -20% -10% 0% 10% 20%

Hood Canal Str. of Georgia Whidbey Basin Central Puget South Sound San Juan Is. All 6 Regions Elliott Bay Commence. Bay Bainbridge Basin All 3 Urban Bays

Taxa Richness

All 6 Regions Elliott Bay Commence. Bay Bainbridge Basin All 3 Urban Bays

* = significant
Bellingham Bay 2010

100% Adversely Affected benthos

2010 (n=30)

Benthic Index
- Green: Unaffected
- Red: Adversely affected
Change Between 1997 and 2006?
Correlation of Benthos & Env. Variables

- Bio-Env (PRIMER)
- Input Variables: Metals, ΣPAHs, TOC, Grain Size, Toxicity Index, Depth
- Spearman correlation = 0.53 (all samples)
- Range 0.57 – 0.80 for individual regions/bays
- Top Variables: Depth, Grain Size, Cd, Toxicity Index
Hypothesis: Changes in the Marine Food Web and Energy Transfer in Puget Sound

**Microbial-based food web**
- + Nitrogen
- + nutrient cycling in the water

**Diatom-based food web**
- Si:N

**Noctiluca**
- Grazing
- 10%

**Zooplankton**
- 10%

**Fish**
- 10%

**Changing food web and more near-surface nutrient cycling**

**Less sinking of diatom particles**

**Decreased coupling between the water and sediment**

**Benthic animals**
- Declining community of organisms in the sediment
# Feeding Guilds

(Macdonald et al., 2012)

<table>
<thead>
<tr>
<th>Surface Detritivore</th>
<th>Subsurface Detritivore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphelochaeta sp N5</td>
<td>Heteromastus filobranchus</td>
</tr>
<tr>
<td>Eudorella pacifica</td>
<td>Cossura pygadactylata</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facultative Detritivore</th>
<th>Benthic Carnivore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axinopsida serricata</td>
<td>Pholoe minuta</td>
</tr>
<tr>
<td>Owenia johnsoni</td>
<td>Odostomia sp</td>
</tr>
<tr>
<td>Euphilomedes carcharodontia</td>
<td>Sigambra bassi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facultative Carnivore</th>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoletoma luti</td>
<td>Suspensivore</td>
</tr>
<tr>
<td>Bipalponephlys comuta</td>
<td>Herbivore</td>
</tr>
<tr>
<td>Lumbrineris californiensis</td>
<td>Planktivorous Carnivore</td>
</tr>
<tr>
<td></td>
<td>Macro-Omnivore</td>
</tr>
</tbody>
</table>
Facultative Detritivores

Abundance (# orgs/0.1 m²)
- 0 - 295
- 300 - 717
- 751 - 1680
- 2188 - 3044
- 4515 - 5387
Other Possible Mechanisms?

- Low DO in porewater and at sediment/water interface
- Ammonia/sulfides
- Changing pH
- Contaminants
  - Point/nonpoint
  - Contaminants of Emerging Concern
  - Slow migration to deeper areas
  - Delayed population-level effects
- Natural cycles