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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

Toxicity: Increase in low-level toxicity

Chemistry: No change or slight improvement

Benthos: Increase in Adversely Affected

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

- Total Abundance
  - Percent Change in Median
  - * = significant

- Taxa Richness
  - Percent Change in Median
  - * = significant

Regions:
- 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

All 6 Regions
- Hood Canal
- Str. of Georgia
- Whidbey Basin
- Central Puget
- South Sound
- San Juan Is.
- All 3 Urban Bays
Bellingham Bay 2010

100% Adversely Affected benthos

2010 (n=30)

Benthic Index
- Green: Unaffected
- Red: Adversely affected

Map of Portage Channel, Bellingham Bay, and Fairhaven.
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

Diatom-based food web

Si:N

Changing food web and more near-surface nutrient cycling

10% 10% 10%

- nutrient cycling in the sediment

+ nutrient cycling in the water

Less sinking of diatom particles

Decreased coupling between the water and sediment

Benthic animals

Declining community of organisms in the sediment

Drawn by Christopher Krembs
# 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 pygodactylata</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>Euphilotomodes carcharodonta</td>
<td>Sigambra bassi</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Suspensivore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyonsia californica</td>
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</tbody>
</table>
Surface Deposit Feeders

Abundance (# orgs/0.1 m2)
- 0 - 143
- 146 - 377
- 410 - 781
- 813 - 1530
- 1789 - 2809
Facultative Detritivores

Abundance (# organs/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