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
- 2\textsuperscript{nd} 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

-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

-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

* = significant
Bellingham Bay 2010

100% Adversely Affected benthos

2010
(n=30)

Benthic Index
- Unaffected
- Adversely affected

Portage Channel
Bellingham Bay
Bellingham
Fairhaven
Change Between 1997 and 2006?

1997 (n=18)

2006 (n=11)

2010 (n=30)

Benthic Index
- Green: Unaffected
- Red: Adversely affected

Portage Channel

Bellingham Bay

Fairhaven
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

Changing food web and more near-surface nutrient cycling

Grazing

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 pygodyactylata</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 carcharodonita</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 cornuta</td>
<td>Herbivore</td>
</tr>
<tr>
<td>Lumbrineris californiensis</td>
<td>Planktivorous Carnivore</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Macro-Omnivore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyonsia californica</td>
<td></td>
</tr>
</tbody>
</table>
Surface Deposit Feeders

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