Lessons from long time-series of benthic invertebrate communities in the southern Salish Sea, and an expansion of parameters to assess nutrient loading and climate change pressures

Valerie Partridge
Washington State Dept. of Ecology, United States, VPar461@ECY.WA.GOV

Margaret Dutch
Washington State Dept. of Ecology, United States, mdut461@ecy.wa.gov

Sandra Weakland
Washington State Dept. of Ecology, United States, sgei461@ecy.wa.gov

Dany Burgess
Washington State Dept. of Ecology, United States, danb461@ecy.wa.gov

Angela Eagleston
Washington State Dept. of Ecology, United States, aeag461@ecy.wa.gov

Follow this and additional works at: https://cedar.wwu.edu/ssec

Part of the Fresh Water Studies Commons, Marine Biology Commons, Natural Resources and Conservation Commons, and the Terrestrial and Aquatic Ecology Commons

Partridge, Valerie; Dutch, Margaret; Weakland, Sandra; Burgess, Dany; and Eagleston, Angela, "Lessons from long time-series of benthic invertebrate communities in the southern Salish Sea, and an expansion of parameters to assess nutrient loading and climate change pressures" (2018). Salish Sea Ecosystem Conference. 539.
https://cedar.wwu.edu/ssec/2018ssec/allsessions/539

This Event is brought to you for free and open access by the Conferences and Events at Western CEDAR. It has been accepted for inclusion in Salish Sea Ecosystem Conference by an authorized administrator of Western CEDAR. For more information, please contact westerncedar@wwu.edu.
Lessons from long time-series of benthic invertebrate communities in the southern Salish Sea

Valerie Partridge*, Margaret Dutch, Sandra Weakland, Dany Burgess, and Angela Eagleston
10 Long-term stations

- Sampled annually 1989 - 2015+
- Variety of habitats
  - depth
  - grain size
  - human influence
- Distinct benthic communities

- Strait of Georgia
- Bellingham Bay
- Port Gardner
- N. Hood Canal
- Shilshole
- Sinclair Inlet
- Point Pully
- Thea Foss W’way
- Anderson Island
- Budd Inlet
What have we learned in ~30 years?

• Trends are complex

• Some communities remarkably stable; others unstable/impaired

• Context important
  – both spatial and temporal
Complex trends over time

<table>
<thead>
<tr>
<th>Chemical Contaminants (individual metals, etc.)</th>
<th>Measures of Community Abundance, Diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="chart.png" alt="Heatmap of chemical contaminants and measures of community abundance and diversity over time" /></td>
<td></td>
</tr>
</tbody>
</table>

Each square = 27-year trend at 1 station for 1 parameter

- **Green**: improvement
- **Red**: deterioration
- **Gray**: mixed up/down
- **White**: no change
- **Black**: all nondetect

10 Long-Term Stations
Communities differ in species, abundance

Box size ~ Total abundance
Font size ~ Species abundance
Each symbol = 1 station in 1 year

Closeness = similarity (both species & abundance)

Years within stations

Stations within habitat types

Community similarities
Community shifts over time

Example: Thea Foss Waterway

Statistically similar years have same symbol

Community shifts possibly related to cleanups?
Functional feeding guilds - stable community

- Integrate what/where/how organisms eat (Macdonald et al., 2010, 2012)

Within feeding guild
- Abundance varies
- Species composition varies

Across feeding guilds
% Abundance \sim \text{constant}
\rightarrow \text{functions conserved}
Functional feeding guilds - known impacted site

Disturbance → community changed
- abundance
- species

→ Feeding guilds continue to change

→ Functions impaired
Sensitive – Tolerant Taxa

- Basis of multi-metric indices (e.g., AMBI)
- No change where community stable
- Sensitive taxa ↓, tolerant taxa ↑ in impaired community

Ecological Group
(Grall & Glémarec, 1997)

<table>
<thead>
<tr>
<th></th>
<th>Sensitive</th>
<th>Tolerant</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Regional results comparison
Example: Strait of Georgia region
...and Long-Term station
Regional changes vs. long-term trends

Measures of abundance & diversity

Sometimes different picture

<table>
<thead>
<tr>
<th>CHANGE</th>
<th>TREND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str Georgia region 1997 vs. 2006</td>
<td>Bellingham Bay station 1989-2015</td>
</tr>
<tr>
<td>Total Abundance ▼</td>
<td>▲</td>
</tr>
<tr>
<td>Taxa Richness</td>
<td></td>
</tr>
<tr>
<td>Evenness</td>
<td></td>
</tr>
<tr>
<td>Dominance</td>
<td>▼</td>
</tr>
<tr>
<td>Annelids ▼</td>
<td>▼</td>
</tr>
<tr>
<td>Arthropods</td>
<td></td>
</tr>
<tr>
<td>Echinoderms</td>
<td>▼</td>
</tr>
<tr>
<td>Molluscs</td>
<td></td>
</tr>
<tr>
<td>Misc. Taxa</td>
<td></td>
</tr>
</tbody>
</table>

▲ improvement
▼ deterioration
□ no change
□ mixed up/down trend
▲ increase
▼ decrease
Regional changes vs. long-term trends

Echinoderm Abundance, Bellingham Bay station

Abundance (# organisms/0.1 m²)


Change in Regional mean
Regional changes vs. Long-term trends

- **Sample sizes**
  - local variability

- **Timing**
  - natural cycles
  - before vs. after bloom

- **Confounding**
  - spatial
  - temporal

El Niño / Southern Oscillation Index

<table>
<thead>
<tr>
<th>Region</th>
<th>LT Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space</td>
<td>1</td>
</tr>
<tr>
<td>Time</td>
<td>27</td>
</tr>
<tr>
<td>Replicates</td>
<td>3</td>
</tr>
</tbody>
</table>
A few more thoughts

• Regional vs. Long-term
  – Complement each other
  – Best of both → new design

• Unique, very important dataset