Identifying nutrient thresholds for sustainable local management of British Columbia seagrass beds

Sarah Bittick
*Univ. of British Columbia, Canada*, bittick@zoology.ubc.ca

Matthew Christensen
*Ducks Unlimited, Canada*, M_Christensen@ducks.ca

Mary I. O’Connor
*Univ. of British Columbia, Canada*, oconnor@zoology.ubc.ca

Nikki Wright
*SeaChange Marine Conservation Network, Canada*, seachange@shaw.ca

Follow this and additional works at: [https://cedar.wwu.edu/ssec](https://cedar.wwu.edu/ssec)

Part of the [Fresh Water Studies Commons](https://cedar.wwu.edu/ssec), [Marine Biology Commons](https://cedar.wwu.edu/ssec), [Natural Resources and Conservation Commons](https://cedar.wwu.edu/ssec), and the [Terrestrial and Aquatic Ecology Commons](https://cedar.wwu.edu/ssec)

Bittick, Sarah; Christensen, Matthew; O’Connor, Mary I.; and Wright, Nikki, "Identifying nutrient thresholds for sustainable local management of British Columbia seagrass beds" (2018). *Salish Sea Ecosystem Conference*. 390.


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.
Identifying nutrient thresholds for sustainable management of seagrass beds

Sarah Joy Bittick, PhD
Liber Ero Postdoctoral Fellow
University of British Columbia
email: bittick@zoology.ubc.ca

@SJBittick #SSEC2018
Boundary Bay Eelgrass

- July 2013, MetroVan Boundary Bay Ambient Monitoring Program
Ecosystem Phase Shifts

Communities can shift in many ways:

- Smooth
  - Predictable

- Abrupt
  - Predictable but “surprise”

- Discontinuous
  - ???

Why is it important to determine between these?

- Predictability and when to take action
Figure 2.5. Ecological indicator groups, which include altered primary producers, sediment and water biogeochemistry, and secondary & tertiary consumers. OM=sediment organic matter accumulation.
Fig. 1. Conceptual diagram illustrating biological response, resistance threshold, exhaustion threshold, and adverse benchmarks along a stressor gradient. The curve represents the level of a biological response variable in regard to the level of stressor.
Paradox of Enrichment

Symptoms of eutrophication

Nutrient concentration

[Graph showing a negative correlation between nutrient concentration and symptoms of eutrophication]
Nutrients Are Masked

Hard to rely on water column nutrients alone

We don't have a nutrient problem!
Macroalgal Assessment Framework

Increased Nutrient Loading

Lauri Green et al, 2014
# Macroalgal Assessment Framework

**Figure 3.7 Proposed assessment framework to diagnose eutrophication using macroalgae for macroalgae in intertidal and shallow subtidal habitat for California estuaries that are “open” to surfacewater tidal**

<table>
<thead>
<tr>
<th>Biomass (g dw m^(-2))</th>
<th>Percent Cover</th>
<th>&lt; 10 %</th>
<th>10 - 25 %</th>
<th>25 - 40 %</th>
<th>40 - 70 %</th>
<th>&gt; 70 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;175</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Very Low</td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td>100 - 175</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
<td>Very low</td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td>70-100</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>50 - 70</td>
<td>High</td>
<td>High</td>
<td>Moderate**</td>
<td>Moderate**</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>15 - 50</td>
<td>Very High</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>&lt; 15</td>
<td>Very High</td>
<td>Very High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

**downgrade if moderate for 2 consecutive sampling periods**
Predictable decline in habitat structure

- Predictable exponential decay model preferred (by AICc)
- Shoot density declines in response to *Ulva*
Predictable exponential decay model preferred

Epiphyte load declines in response to *Ulva*
Macroalgal assessment framework: eelgrass

<table>
<thead>
<tr>
<th>Biomass (g dw m⁻²)</th>
<th>Condition Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;140</td>
<td>Very low</td>
</tr>
<tr>
<td>70-140</td>
<td>low</td>
</tr>
<tr>
<td>30 - 70</td>
<td>Moderate</td>
</tr>
<tr>
<td>15 - 30</td>
<td>High</td>
</tr>
<tr>
<td>&lt; 15</td>
<td>Very high</td>
</tr>
</tbody>
</table>

Review of Indicators for Development of Nutrient Numeric Endpoints in California Estuaries, Martha Sutula et al. report for California EPA, State Water Resources Board
Nutrient “Tipping-Points” in Boundary Bay

- Water quality monitoring
- +/- Nutrient manipulation experiment at multiple sites in BB
- Nutrient loading model
  - Comparison with East Coast

CHOne
CANADIAN HEALTHY OCEANS NETWORK
Indicator of shifts: invertebrate community

- Experiments in Boundary Bay to identify threshold levels of nutrient enrichment before invertebrate diversity shifts

PC: Matthew Whalen (L,M), Lauri Green (R)
Approach: Community Engagement

- Shared Waters
  - Transboundary watershed management

- Local stakeholders

- Community citizen science
  - Water quality monitoring
  - Invertebrate community ID
Acknowledgements

BC:
Matthew Christensen
O’Connor Lab (UBC)
Nikki Wright
Arocha Canada

California:
Peggy Fong
Lauri Green
Martha Sutula
Art Credits

- Tracey Saxby
- Diane Kleine
- Dylan Taillie
- Kim Kraeer, Lucy Van Essen-Fishman
General Overview

1. Context of eelgrass in Boundary Bay, BC
2. Ecosystem responses to human stressors
3. Nutrients & Macroalgal Indicators
4. Macroalgal Assessment Framework
5. Nutrient “tipping-points” in BC eelgrass beds