Nutrient bioextraction using wild set of blue mussels (*Mytilus trossulus*) in Budd Inlet, southern Puget Sound, Washington State

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Outline

1. Pacific Shellfish Institute: Who we are
2. Nutrient bioextraction in concept
3. Our pilot research
4. 2013-2014 mussel growth in Budd Inlet (lots of pictures)
5. Public & private outreach success
6. Compost trials
7. A little data growth and N content
8. Conclusions

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All PSI staff bios at www.pacshell.org
Pacific Shellfish Institute (PSI): Who we are

1. Olympia, Washington based 501c(3)
2. Established in 1995 with strong linkages to the Pacific Coast Shellfish Growers Association (PCSGA)
3. In 2004, PSI Bylaws were changed to provide a clearer separation
4. PSI’s funding source:
   - Largely competitive federal grants
   - Some private foundation grants
5. High level of industry cooperation and in-kind support
6. Partnerships are very important
Shellfish at Work: Nutrient Bioextraction

Under this dock thousands of mussels are growing. A single mussel can filter 13 gallons of water in a day, improving water clarity and incorporating nutrients into their tissues. As part of an innovative research project here in Budd Inlet, these mussels will be harvested, tested, and turned into rich compost. Researchers will then be able to calculate the amount of nitrogen and phosphorus removed from Budd Inlet.

Nutrient Bioextraction:
Growing and harvesting shellfish or seaweed to remove nutrients from natural water bodies. Also called nutrient bioharvesting.

Budd Inlet experiences low dissolved oxygen in late summer and early fall, similar to Hood Canal. Low dissolved oxygen, or eutrophication, can be harmful to marine life and raises concerns about Budd Inlet’s overall health.

Low oxygen levels occur when excess nutrients stimulate phytoplankton growth. Phytoplankton are microscopic plants, and when they die the decay process depletes oxygen levels in the water column.

Nutrient Removal by Shellfish

You Can Help Reduce Nutrient Pollution

1. Choose organic, slow release fertilizers and phosphate-free cleaning products
2. Properly dispose of pet waste: Scoop it, Bag it, Trash it!
3. Manage farm manure responsibly

Pacific Shellfish Institute
www.pacshell.org
(360) 754-2741
Fostering sustainable shellfish resources and a healthy marine environment through research and education
Where has this idea been applied?

One mussel contains:
0.8 - 1.2 % N
0.06 - 0.08 % P

Agro–Aqua recycling of nutrients using mussel farming as a recycling engine.

Odd Lindahl, 2008
100–150 t/ha mussel biomass harvested every 2nd year

1.2–1.8 t of N
0.08–0.12 t of P

Baltic Sea Region Programme 2007-2013
This Project’s Funding & Partners

EPA’s National Estuary Program (NEP) via WA Dept. of Ecology

Partners:

• Puget Sound Restoration Fund (PSRF)
• City of Olympia
• Port of Olympia
• LOTT (Lacey Olympia Tumwater Thurston county) water treatment provider
• The Evergreen State College
• WA Dept. of Corrections
• Washington State University (WSU- Puyallup Extension Facility)
Budd Inlet Nutrient Reduction Study

WA Dept. of Ecology 2008 Water Quality Assessment
West Bay  
June  
Hearthfire

Boatworks  
Boston Harbor
West Bay  
Early July  
Hearthfire  
Boatworks

Boston Harbor
Mid July

West Bay

Hearthfire

Boatworks

Boston Harbor

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August

West Bay

Hearthfire

Boatworks
Data Collection

Mussel Growth
Mussel Biomass
Temp, Salinity, pH
Dissolved oxygen
Phytoplankton/Secchi
Fouling/Diversity
Community Outreach

Recording mussel lengths/weights & community assemblages on lines

GoPro underwater video
Composting Trials
Washington State University (WSU)
Dept of Corrections - Cedar Creek Composting

In-Vessel Composting System
by DT-Environmental, Lynden, WA
The Evergreen State College Composting Trial

Secret Recipe:
Mussels
Compost
Green Waste
Wood Chips

Evergreen – 900 lbs
WSU – 1000 lbs
WA Dept. Corrections – 1600 lbs
Backyards and labs – 1300 lbs
AmTest Results
Tissue + Shell

Nutrients (% - wet wt)

Metals (µg/g - dry wt)

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# Soiltest Compost Results (triplicate averages)

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<tr>
<th>Element</th>
<th>BUDD</th>
<th>Units</th>
<th>Typical Range</th>
<th>WAC limit</th>
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<tr>
<td>Calcium</td>
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<td>%</td>
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<td>Sodium</td>
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<td>%</td>
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<td>Copper</td>
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<td>mg/kg-dry</td>
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<tr>
<td>C/N</td>
<td>22</td>
<td>ratio</td>
<td>18-24</td>
<td></td>
</tr>
</tbody>
</table>
Average Weight per Mussel (g)

Total potential = 8,760 pounds
Actual harvested = 4,826 pounds
Preliminary Nutrient Removal

8,760 lbs mussels \( \times \) 1% N

= 88 lbs N removed

0.73 lbs/day

LOTT 2017 upgrade

$25 million *capital costs only*

4.0 to 2.25 mg/L or 113 lbs/day N reduction
Our pilot x 240 = 12,096 lbs N over 4 months (100 lbs/day)

~1 football field
288,000 ft \(^3\)

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Conclusions

1. The community learned about local water quality issues
2. We’ve removed nutrients through source control and nutrient bioextraction
3. Results will be used to provide a framework for a potential nutrient-trading concept
4. More research is needed to better understand localized nutrient dynamics:
   - biodeposition
   - seston depletion
   - dissolved oxygen (DO)
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