



Western Washington University
Western CEDAR

Salish Sea Ecosystem Conference

2014 Salish Sea Ecosystem Conference
(Seattle, Wash.)

May 2nd, 1:30 PM - 3:00 PM

Shellfish at Work: Nutrient Bioextraction Demonstration in South Puget Sound

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Christy, Aimee; Suhrbier, Andrew; and Hudson, Bobbi, "Shellfish at Work: Nutrient Bioextraction Demonstration in South Puget Sound" (2014). *Salish Sea Ecosystem Conference*. 99.
<https://cedar.wwu.edu/ssec/2014ssec/Day3/99>

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Shellfish At Work!

Nutrient Bioextraction Research in Budd Inlet & Thea Foss Waterway



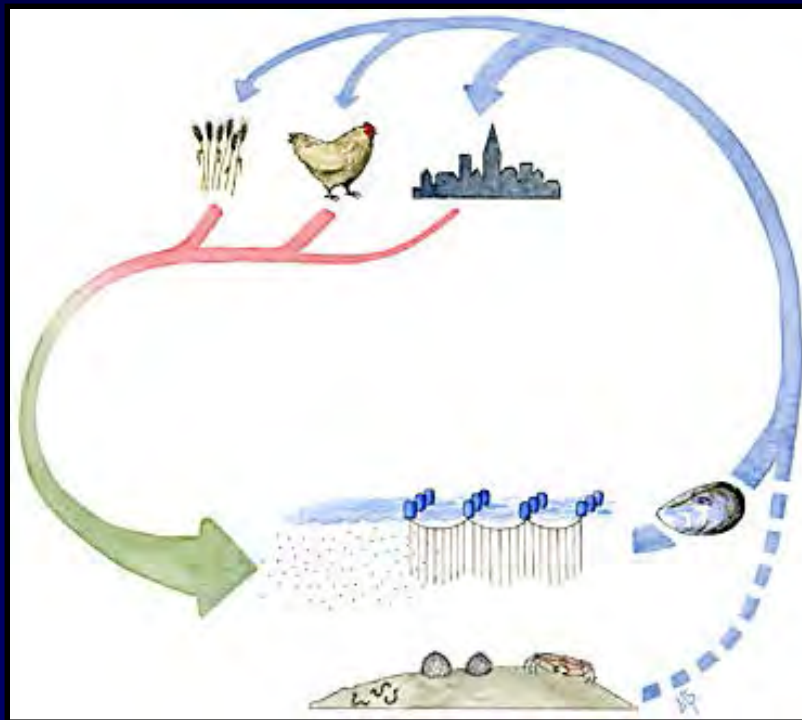
Aimee Christy, Andrew Suhrbier & Bobbi Hudson
Salish Sea Ecosystem Conference
Seattle, April 30 - May 2, 2014



*Pacific
Shellfish
Institute*

What is Nutrient Bioextraction?

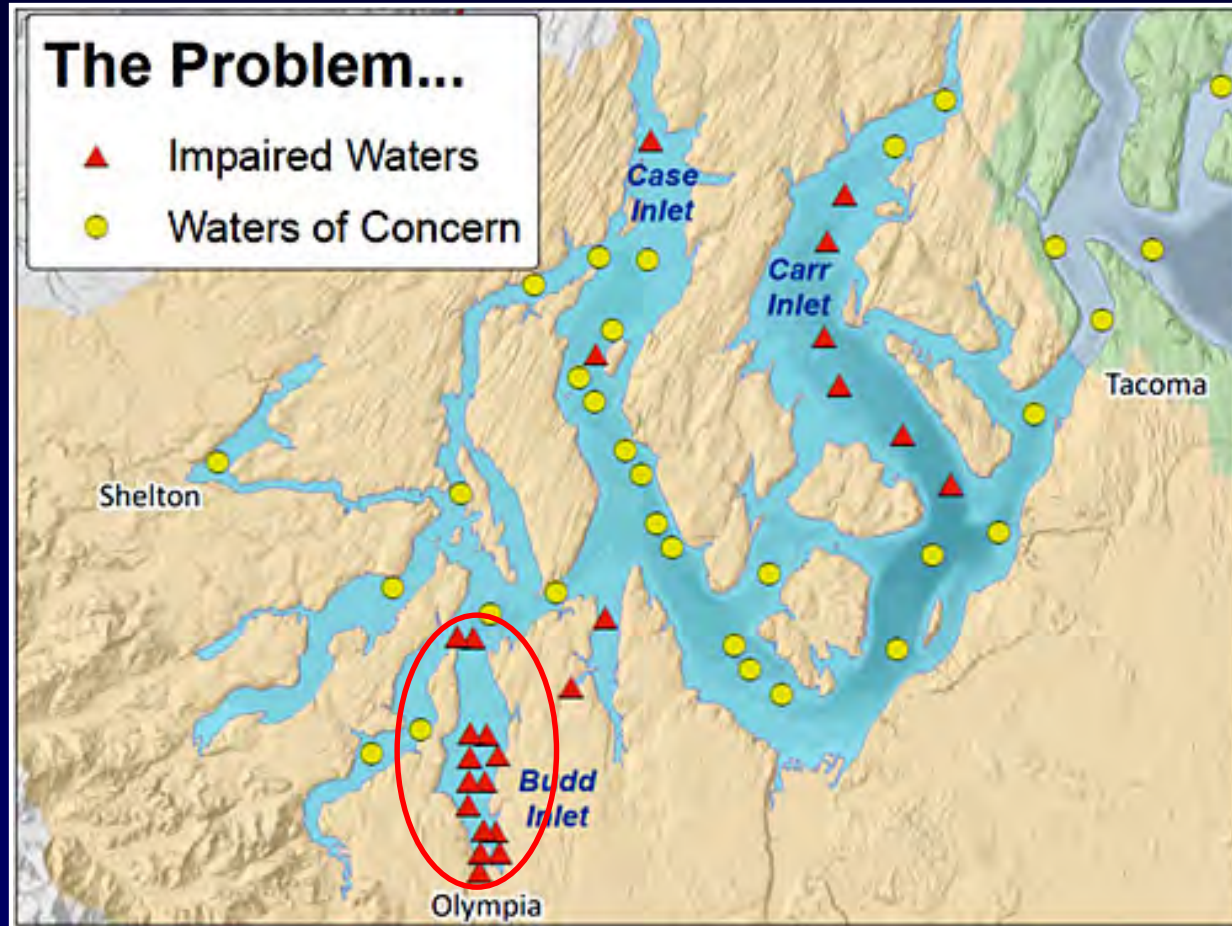
Growing and harvesting shellfish and seaweed to remove nutrients from natural water bodies. Also called nutrient bioharvesting.



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

Odd Lindahl, 2008

Budd Inlet Nutrient Reduction Study



WDOE 2008 Water Quality Assessment

Budd Inlet





101
West Bay

Budd Inlet Sites

May 2013

314 3-5 ft
weighted nylon straps

Boston Harbor **81**



76
Boatworks



56
Hearthfire

Thea Foss Waterway

April 2013, ~100 straps total



Center for Urban Waters



Center for Urban Waters

Marine Floats

Johnny's Dock

Data Collection

Mussel Growth
Mussel Biomass
Temperature
Salinity
pH
Dissolved oxygen
Phytoplankton/Secchi
Fouling/ Diversity



Community Outreach



Recording mussel lengths/weights
& community assemblages on lines



GoPro underwater video

June

West Bay



Hearthfire



Boatworks

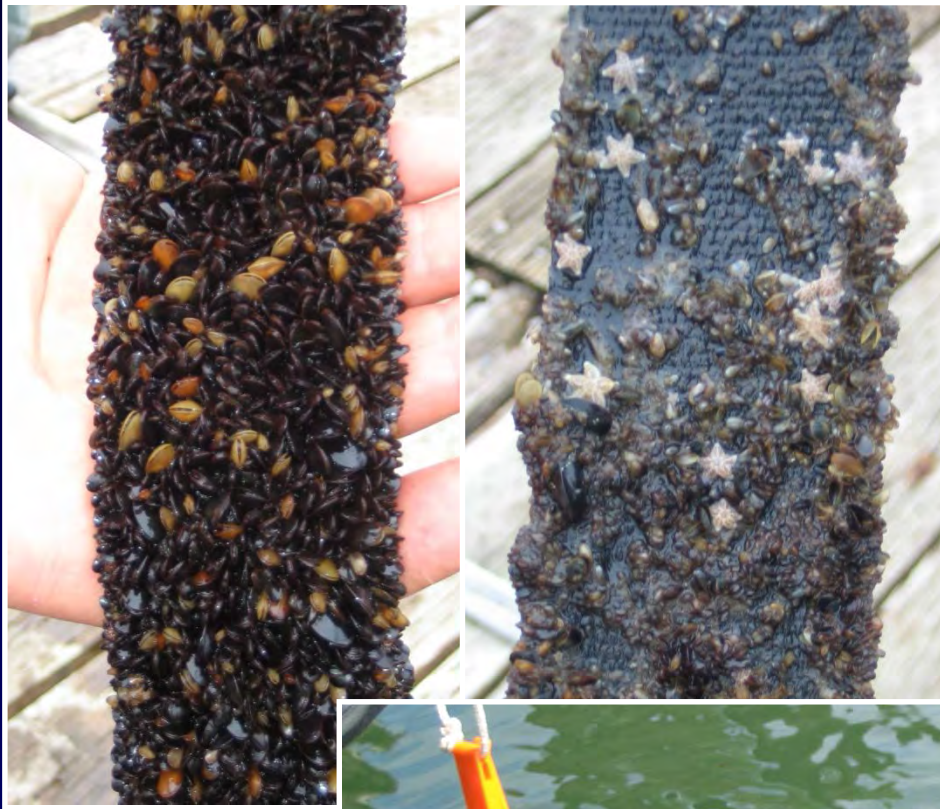


Boston Harbor



Early July

West Bay



Hearthfire



Boatworks



Boston Harbor

Mid July

West Bay



Hearthfire



Boatworks



Boston Harbor



August

West Bay



Hearthfire



Boatworks



September



Washington State University Puyallup Research & Extension Service



WSU Compost Trial



The Evergreen State College Organic Farm

Secret Recipe:

Mussels

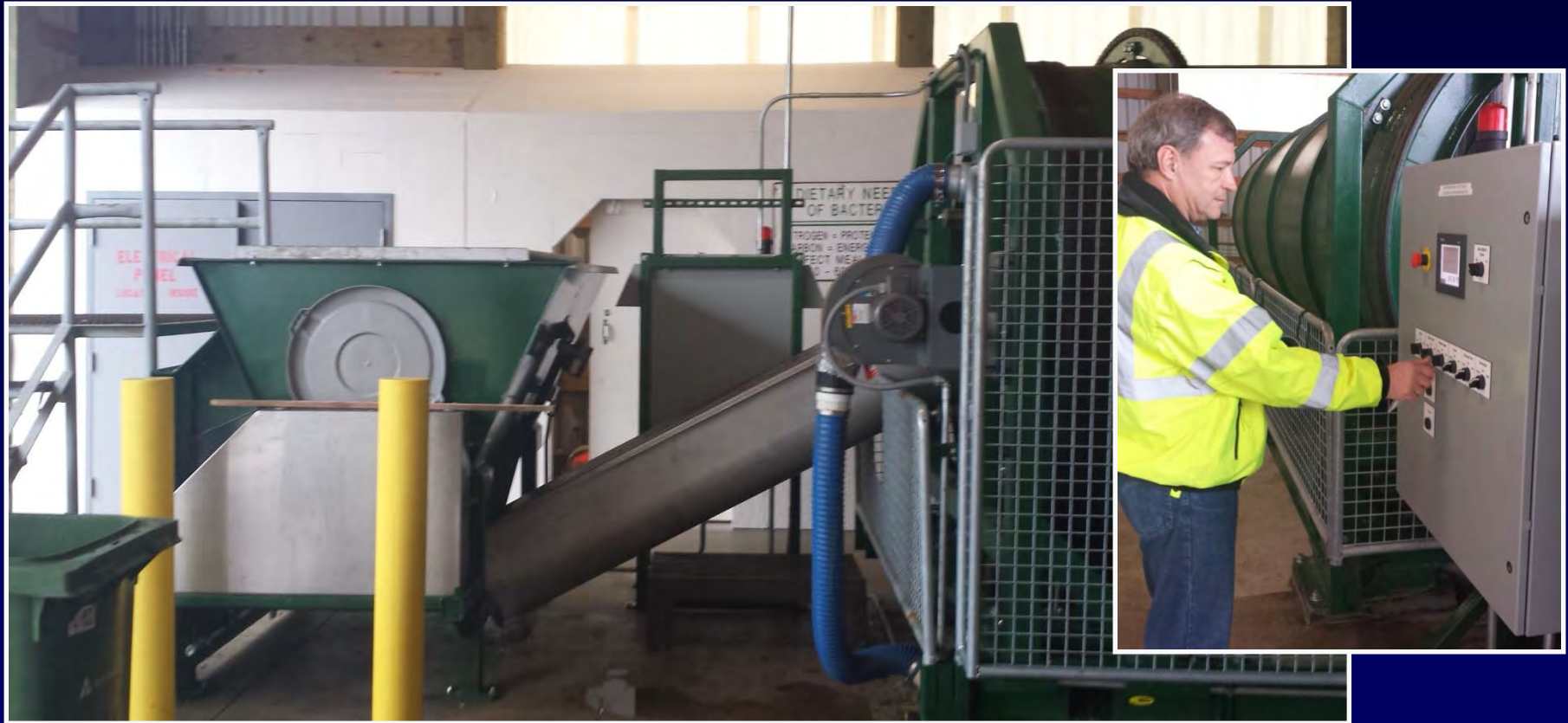
Compost

Green Waste

Wood Chips



Washington Department of Corrections - Cedar Creek & WCCW Composting



Enviro-Drum In-Vessel Composting System
by DT-Environmental, Lynden, WA

Compost Results

Triplicate Averages



Element	BUDD	Units	Typical Range	WAC limit
Calcium	13.3	%	0.5-10	
Sodium	0.48	%	0.05-0.7	
Copper	29	mg/kg-dry	100-500	750
Arsenic	0.4	mg/kg-dry		20
C/N	22	ratio	18-24	

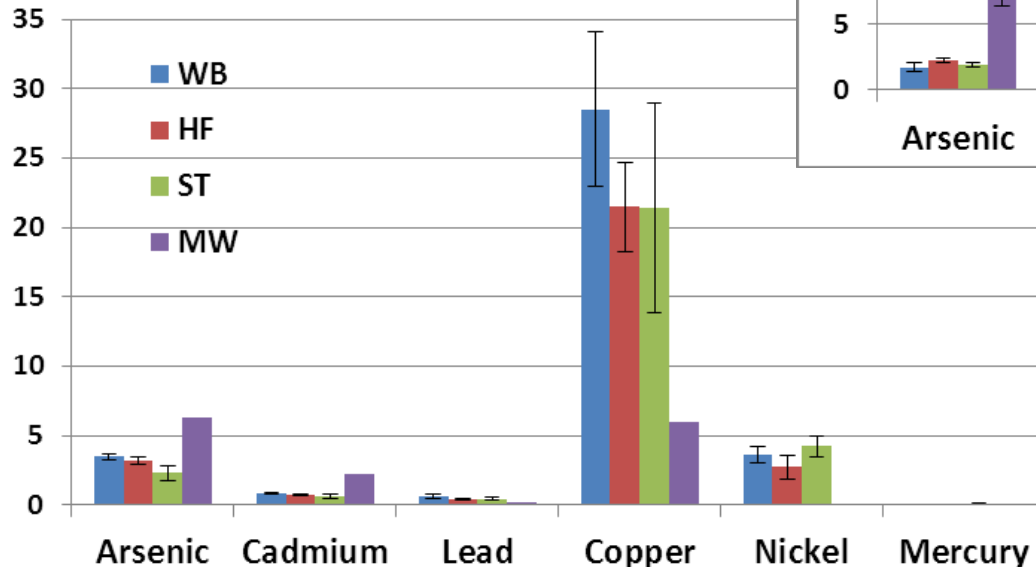
AmTest Laboratory Results

Triplicate Averages

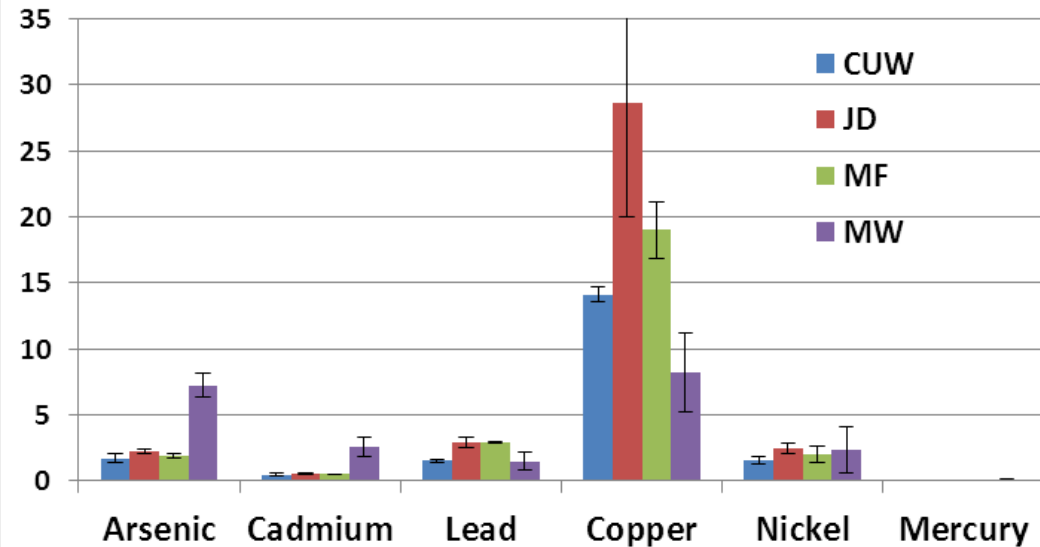
150 mussels per composite

Tissue and shell combined

Budd Inlet Metals (ug/g - dry)

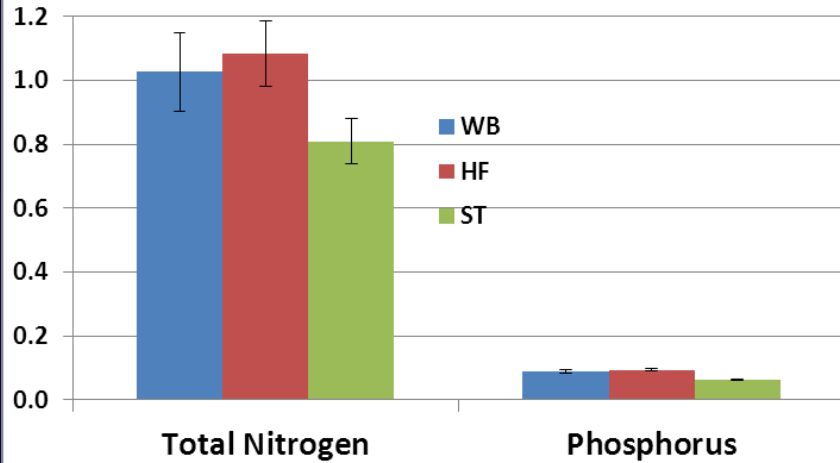


Thea Foss Metals (ug/g - dry)

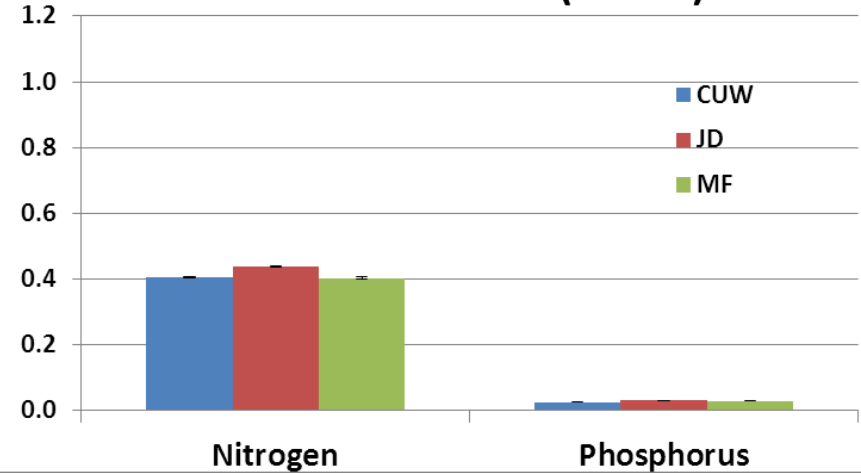


AmTest Laboratory Results

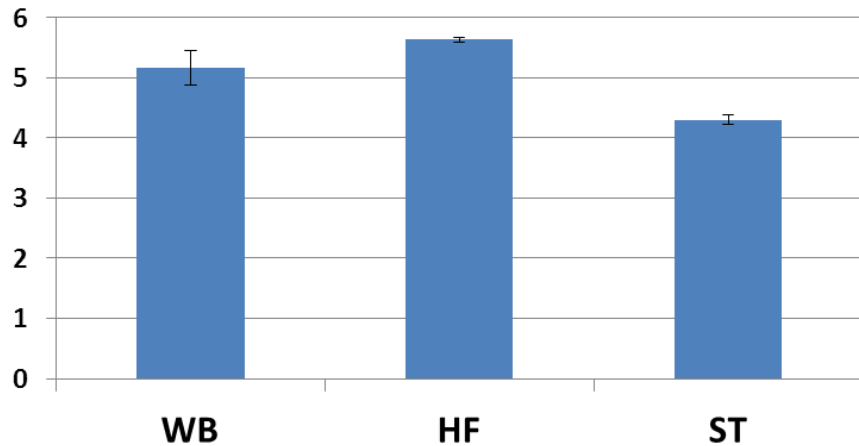
Budd Inlet Nutrients (% - wet)



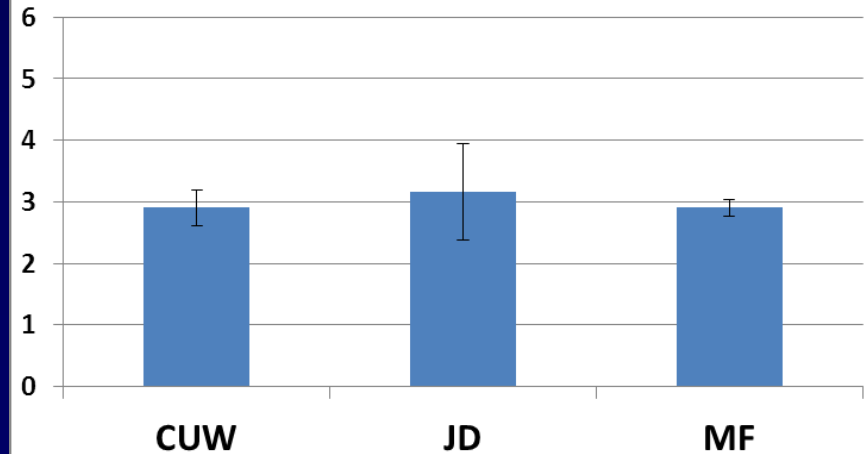
Thea Foss Nutrients (%-wet)



Budd Inlet Total Carbon (% - wet)



Thea Foss Total Carbon (%-wet)

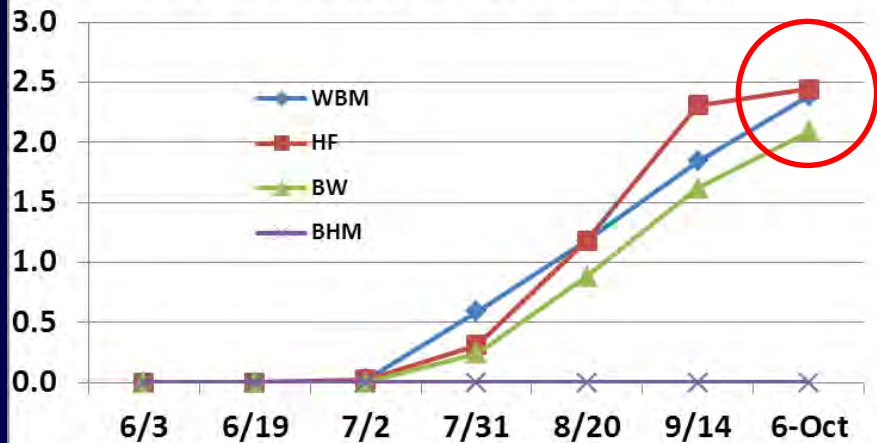


Average Weight per Mussel (g)

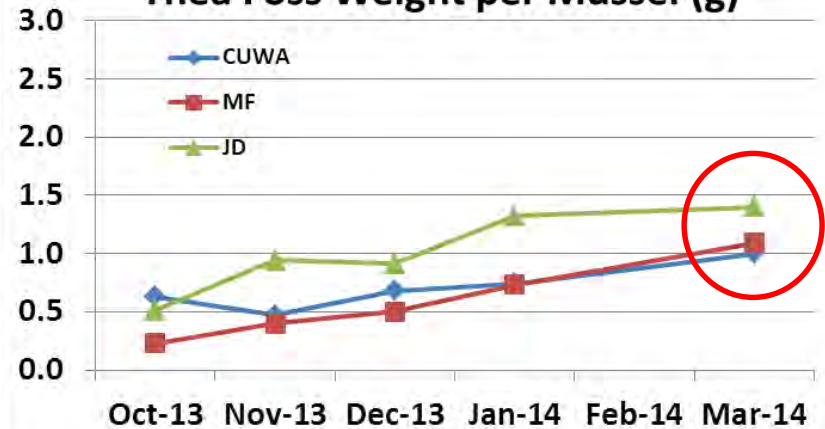
4 months

8+ months

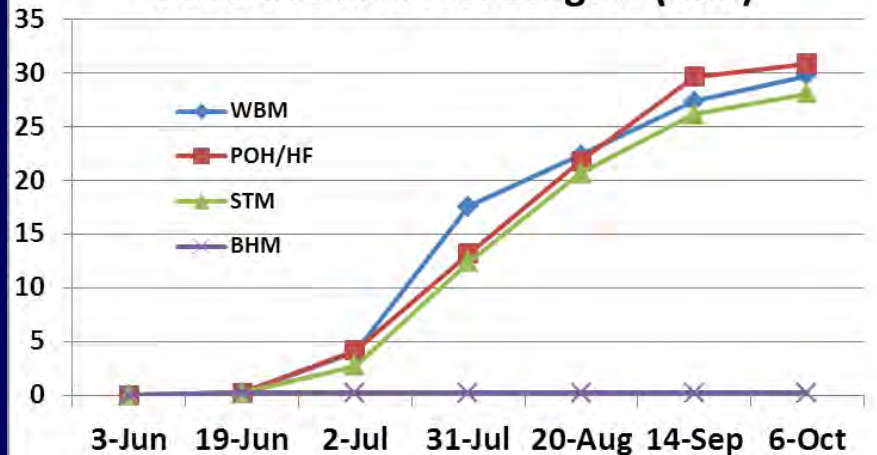
Budd Inlet Weight per Mussel (g)



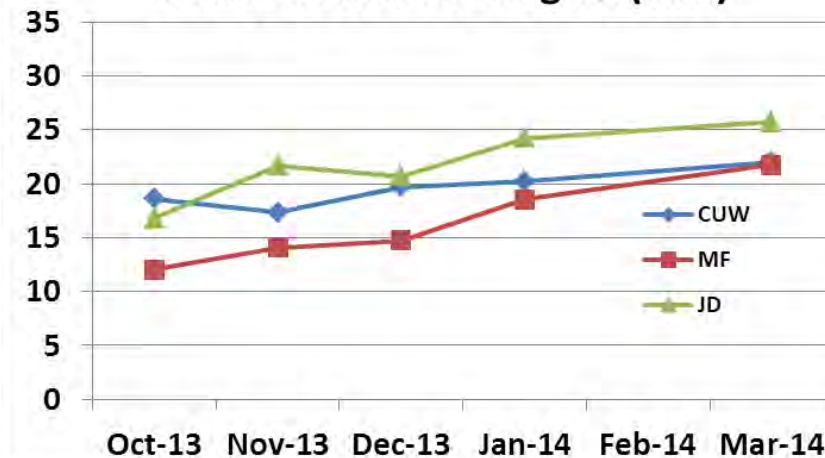
Thea Foss Weight per Mussel (g)



Budd Inlet Mussel Lengths (mm)



Thea Foss Mussel Lengths (mm)



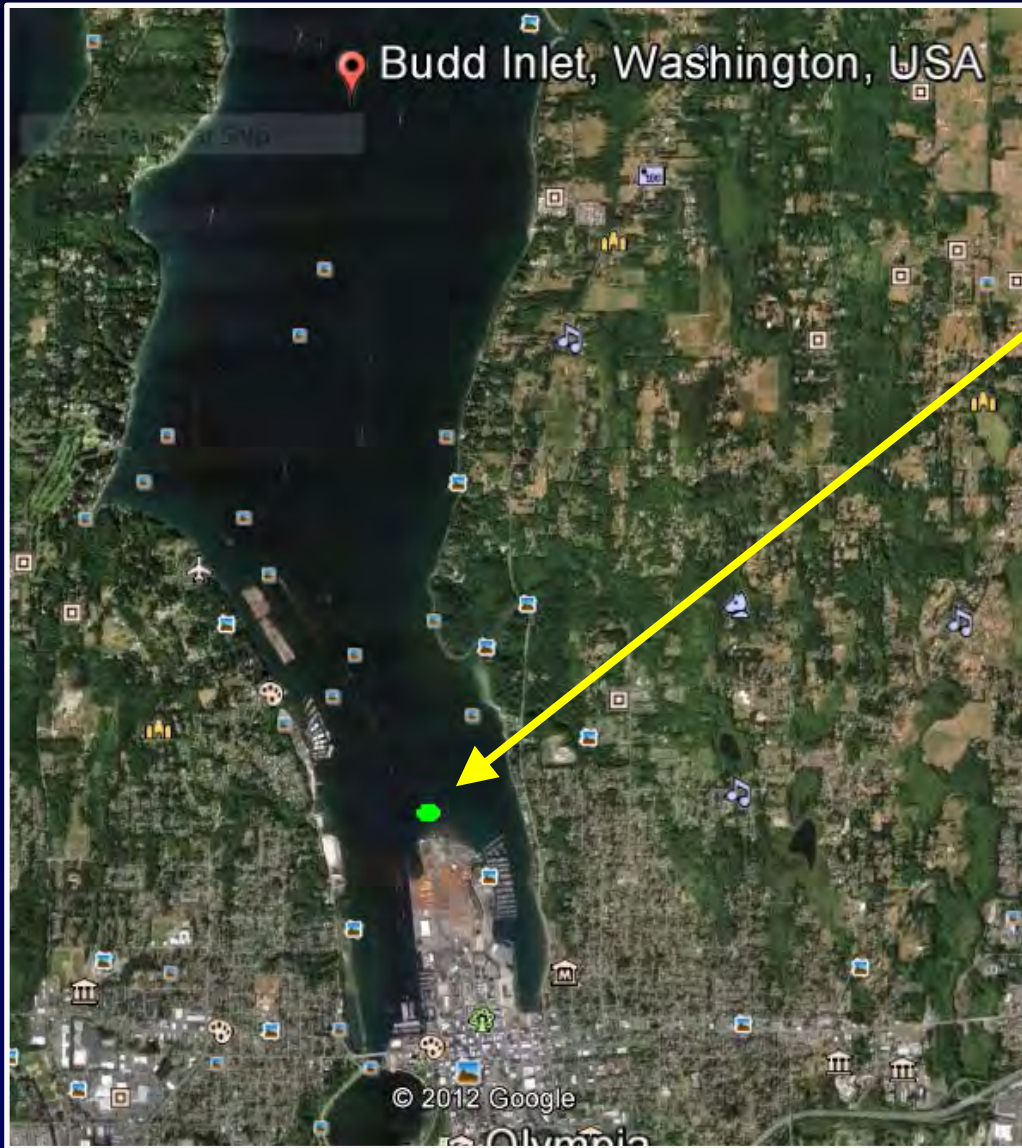
Preliminary Nutrient Removal Results



8,760 lbs mussels
X 1% N
=
88 lbs N removed
0.73 lbs/day



LOTT 2017 upgrade
\$25 million *capital costs only*
113 lbs/day N reduction



30, 240 straps
1,209,600 lbs mussels
12,096 lbs N removed

100 lbs N per day
(over 4 mths)

Image by Susan Burke, Northern Economics

Conclusions

1. The community learned about local water quality issues
2. Nutrients were removed 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)



Special Thanks...



WSU-Puyallup

UW-Tacoma

The Evergreen State College

WA Dept. of Corrections

Squaxin Tribe

Olympia StreamTeam & Volunteers

LOTT Alliance

Port of Olympia

West Bay and Boston Harbor Marinas

Puget Sound Restoration Fund

Funding:

National Estuary Program (NEP) funds

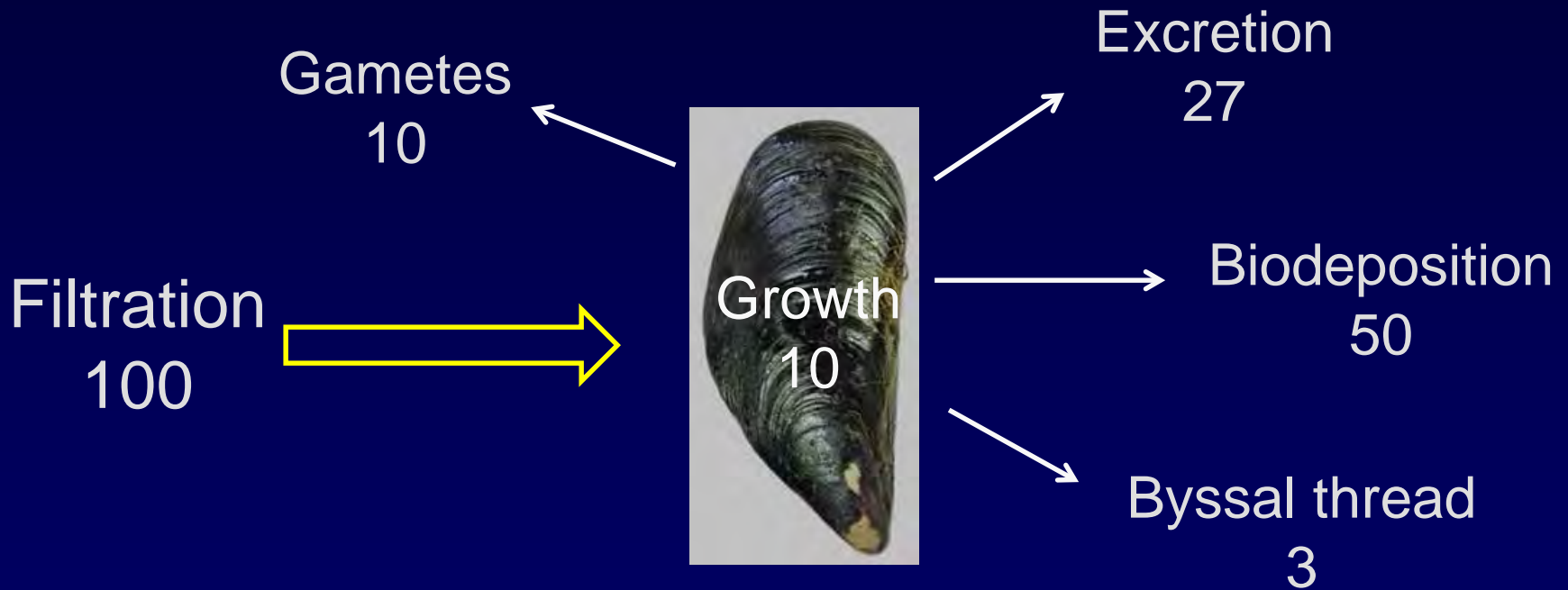
The Russell Family Foundation

Questions?



Relative Nitrogen Flux in New England Salt Marsh Mussels (%)

Jordan & Valiela, 1982



Ecology of Marine Bivalves: An Ecosystem Approach
Richard Dame

Budd Inlet Bottom Substrate

