



Apr 4th, 1:45 PM - 2:00 PM

Comparison of *Alexandrium* spp. surface sediment cyst maps from Quartermaster Harbor in 2007 and 2017

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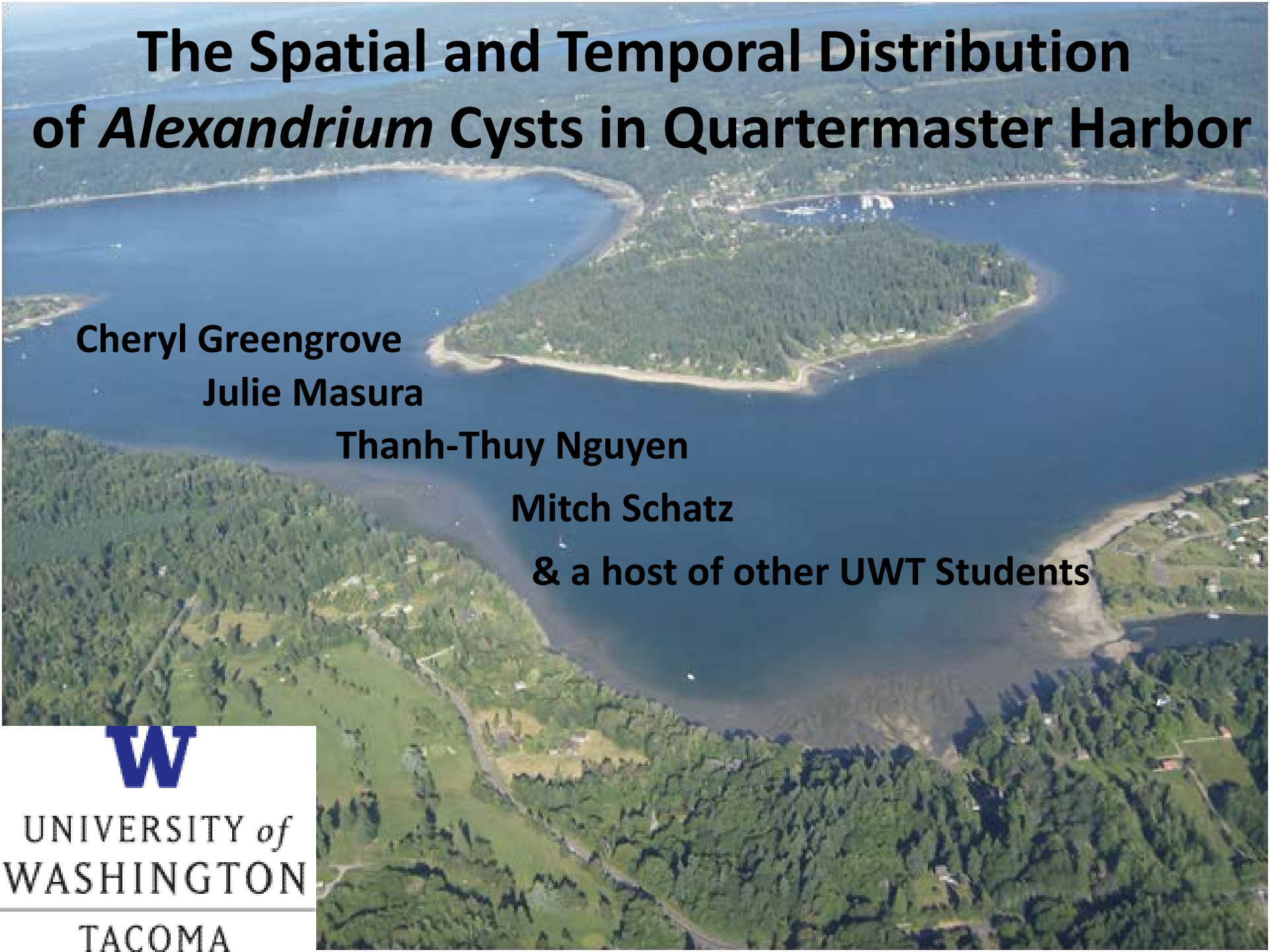


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Greengrove, Cheryl; Masura, Julie; Nguyen, Thanh-Thuy; and Schatz, Mitchell, "Comparison of *Alexandrium* spp. surface sediment cyst maps from Quartermaster Harbor in 2007 and 2017" (2018). *Salish Sea Ecosystem Conference*. 23.

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The Spatial and Temporal Distribution of *Alexandrium* Cysts in Quartermaster Harbor

Cheryl Greengrove

Julie Masura

Thanh-Thuy Nguyen

Mitch Schatz

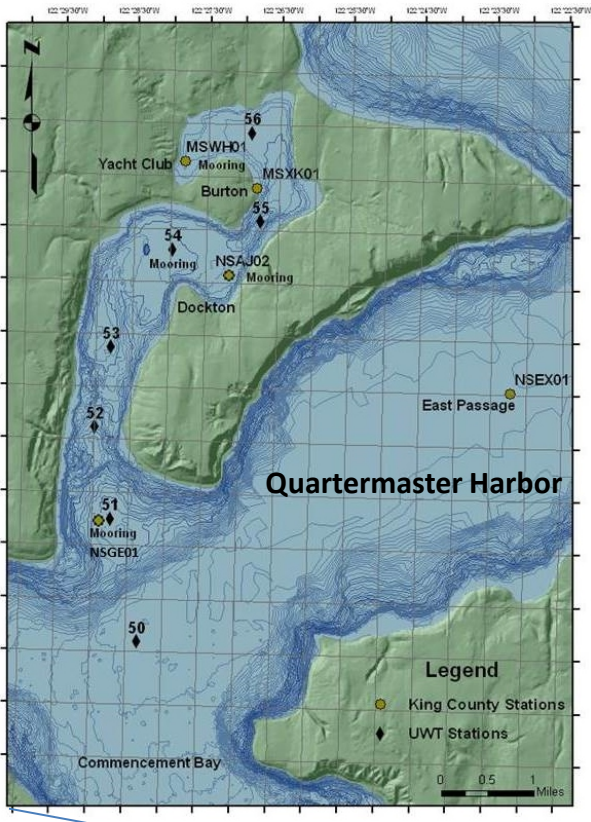
& a host of other UWT Students



UNIVERSITY of
WASHINGTON

TACOMA

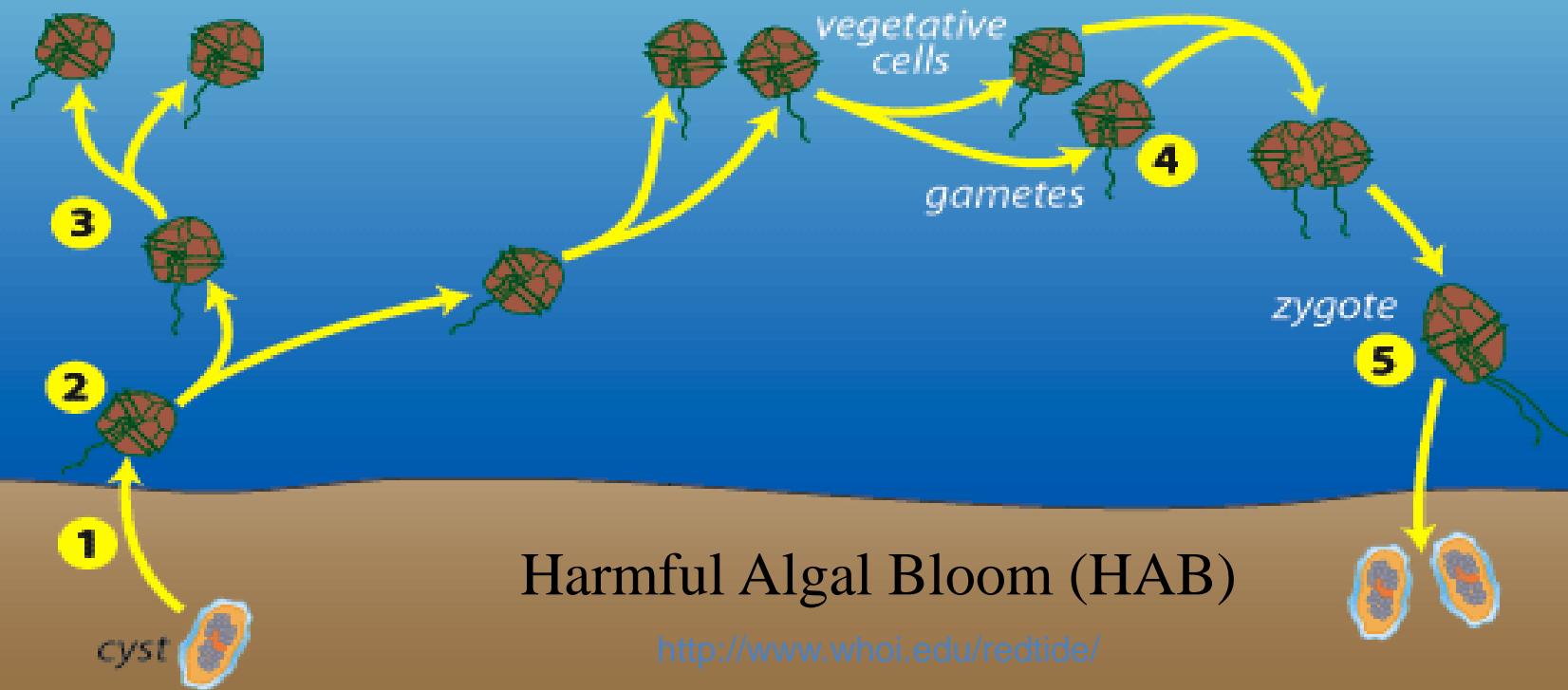
Puget Sound Watershed



Salish Sea



Life Cycle of a Harmful Alga: *Alexandrium*

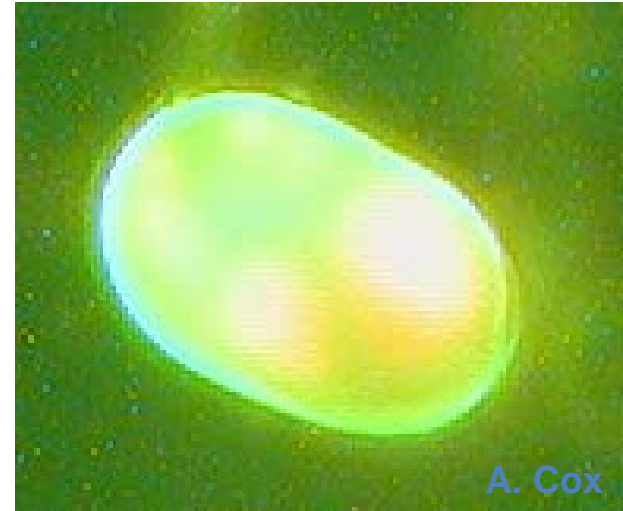
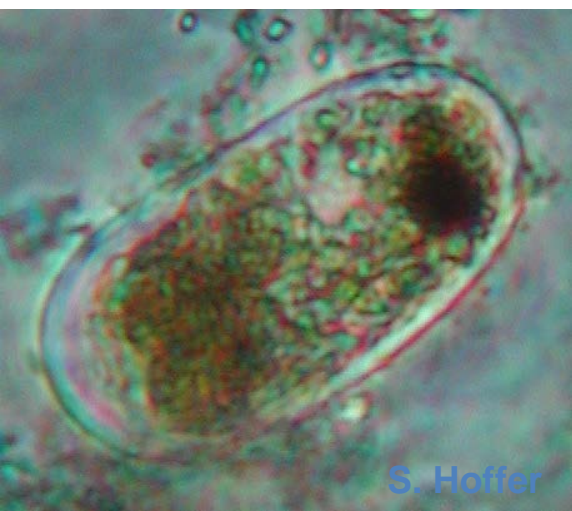


Harmful Algal Bloom (HAB)

<http://www.whoi.edu/redtide/>

Dinoflagellate

Paralytic Shellfish Toxin (PST) Producer



The Puget Sound *Alexandrium* Harmful Algal Bloom (PS-AHAB) project laboratory experiments found:



thou all-destroying but unconquering cell
 from hell's heart I stab at thee
 for hate's sake I spit my last breath at thee
 Sink all coffins and all hearses to one common pool
 and since neither can be mine, let me then tow to pieces,
 while still chasing thee, though tied to thee, thou damned cell!

PS-AHAB

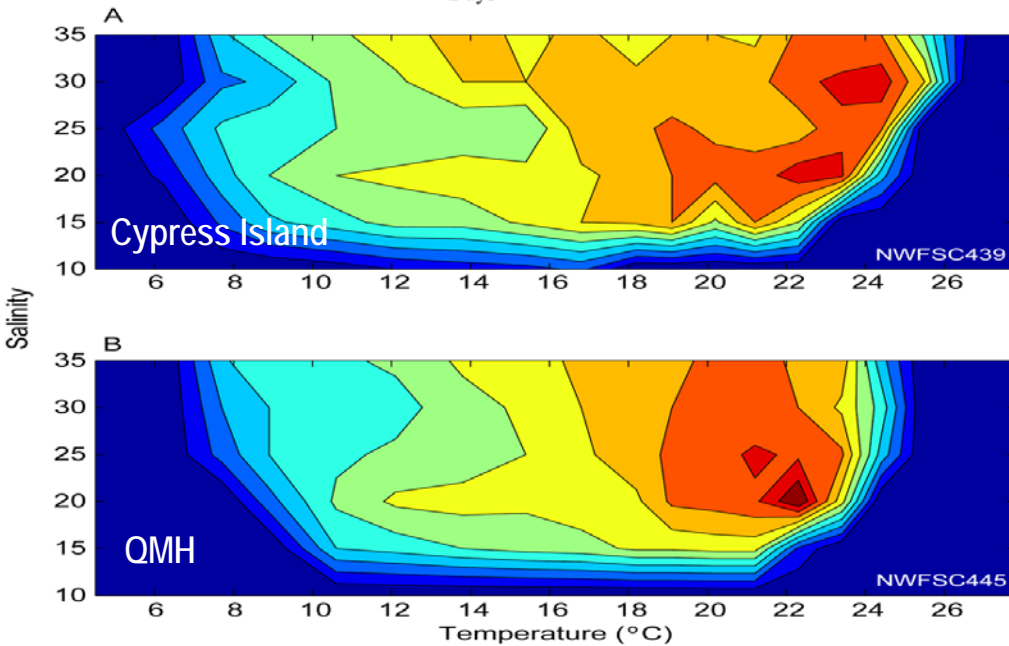
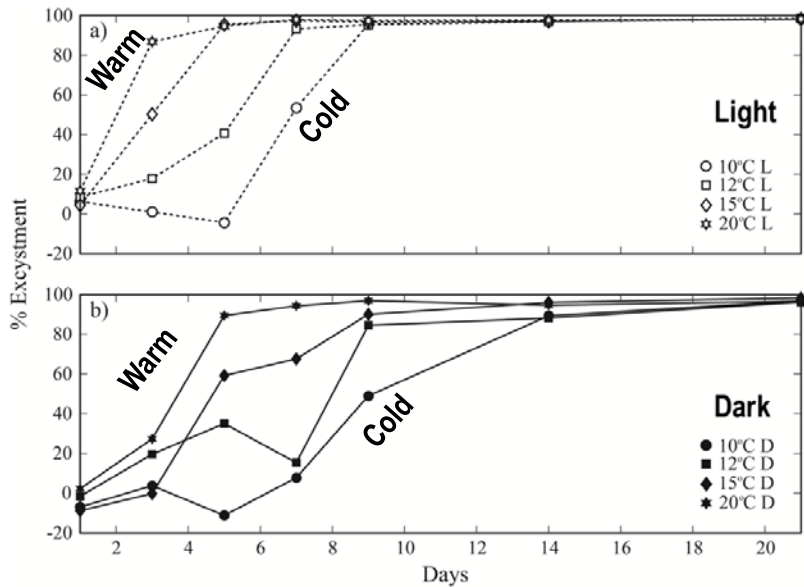
All that most maddens and torments;
 all that stirs up the lees of things;
 all that cracks the sinews and cakes the brain;
 all the subtle demonisms of life and thought;
 all evil, to crazy Ahab, were visibly personified,
 and made practically assailable in *Alexandrium*.
 He piled upon the cell's thecal plates
 the sum of all the general rage and hate
 felt by his whole race from Adam down;
 and then, as if his chest had been a mortar,
 he burst his hot heart's shell upon it.

Factors controlling cyst germination

Prefers light and warmer conditions

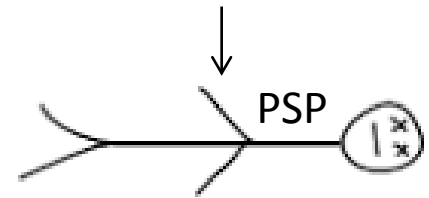
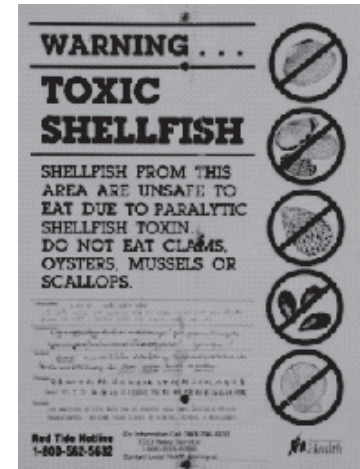
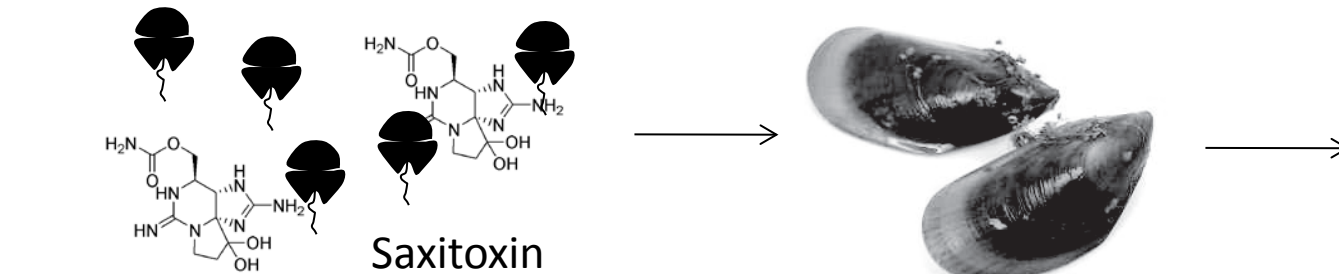
Puget Sound *Alexandrium* growth rates

Puget Sound *Alexandrium* are euryhaline (20-35 psu) with a broad optimal temperature range (13-24°C)



Bill, BD, SK Moore, LR Hay, VL Trainer, DM Anderson.
 2016. Effects of temperature and salinity on growth and toxicity of *Alexandrium* isolates from Puget Sound, WA, USA. *Journal of Phycology*, 52, 230–238.

Why do we care?



What are the ways we can detect *Alexandrium* and Paralytic Shellfish Toxins (PSTs)?

- Cysts in the sediment
- Vegetative cells in the water column
- PSTs in shellfish



Alexandrium outbreaks, shellfish toxicity, & human illnesses have plagued Puget Sound for decades

Native American Stories & Ship Logs



1793



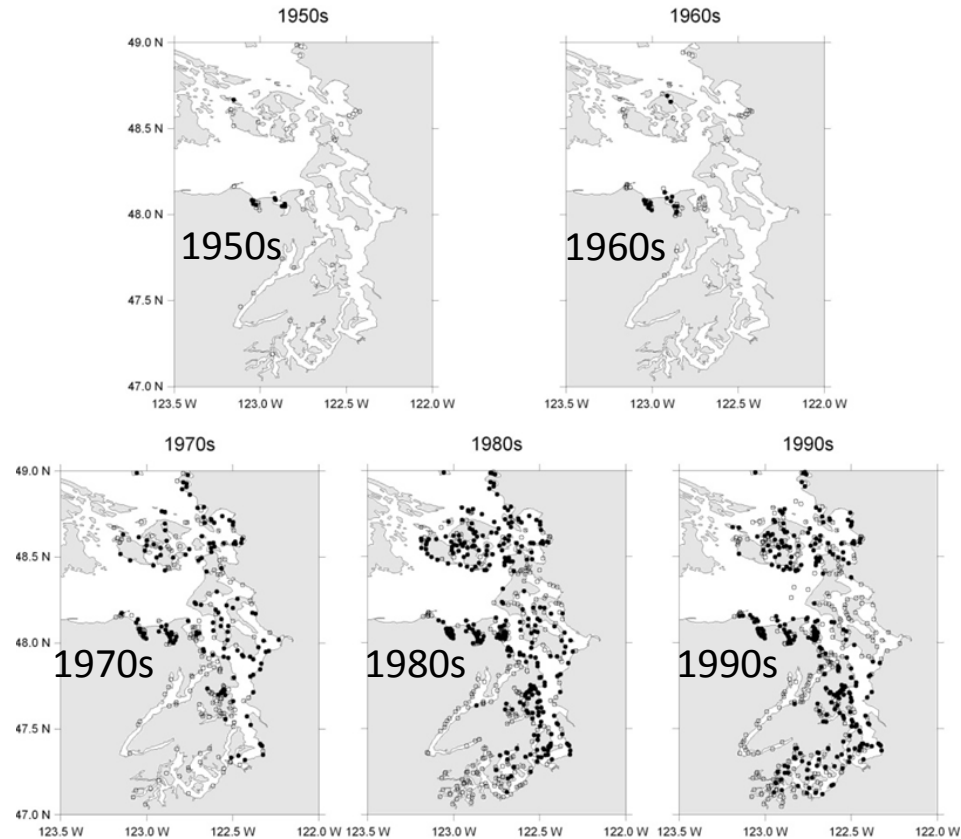
HMS Discovery

Captain George Vancouver
<http://www.vancouvermaritimemuseum.com>

PSP More Recently:

- 1942 – 3 deaths
- 2012 – 9 reported PSP illnesses
- Most years – shellfish bed closures

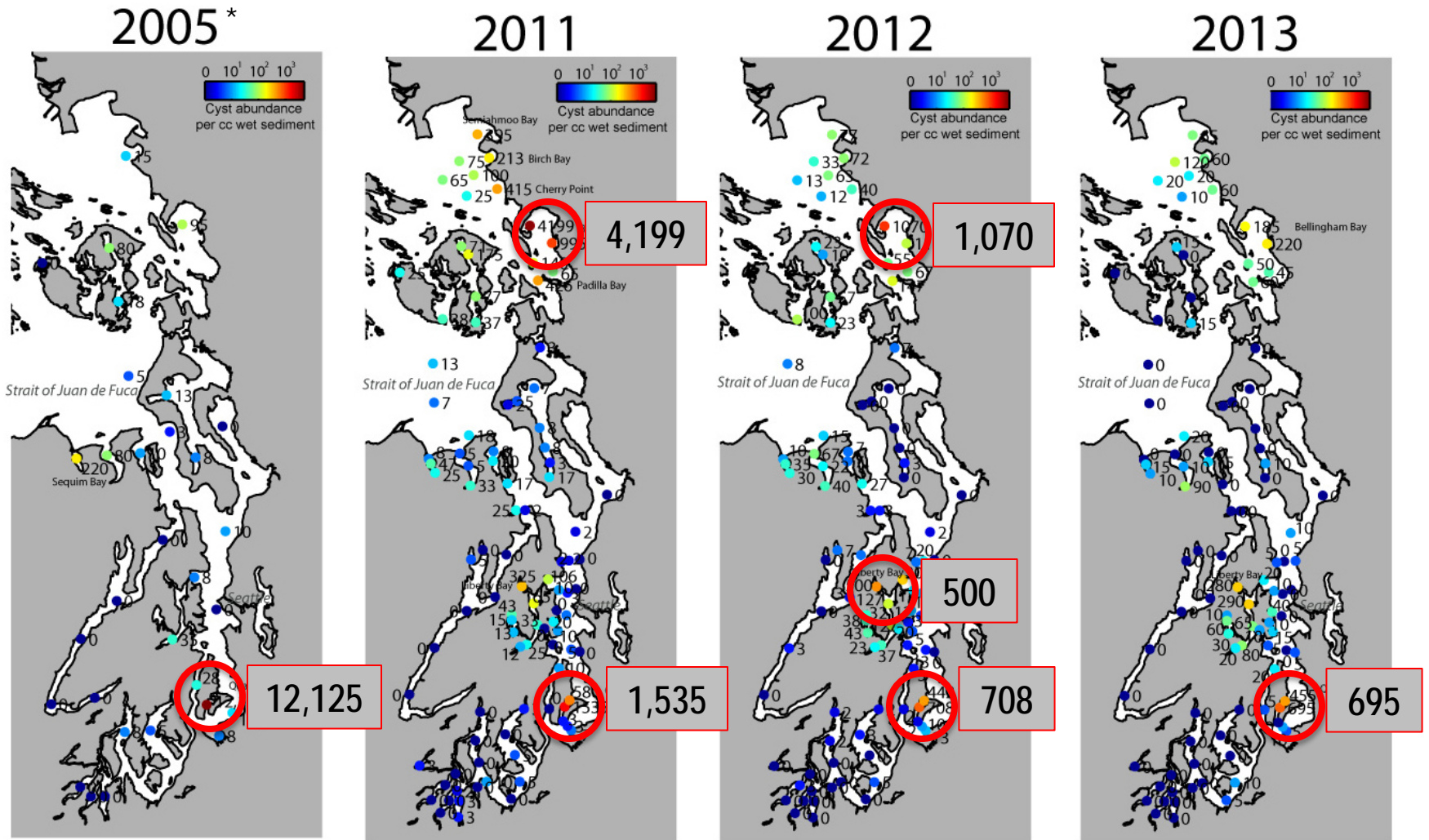
Shellfish Bed closures due to PST



Shellfish harvesting closures due to PST by decade in Puget Sound based on Washington State Department of Health (WDOH) monitoring data. Trainer *et al.* (2003)

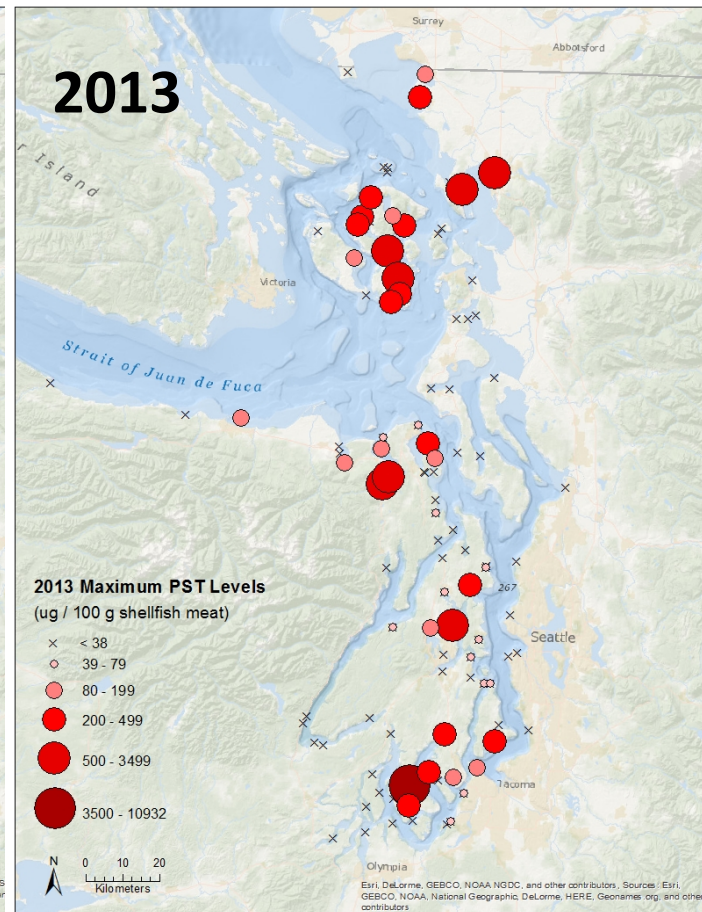
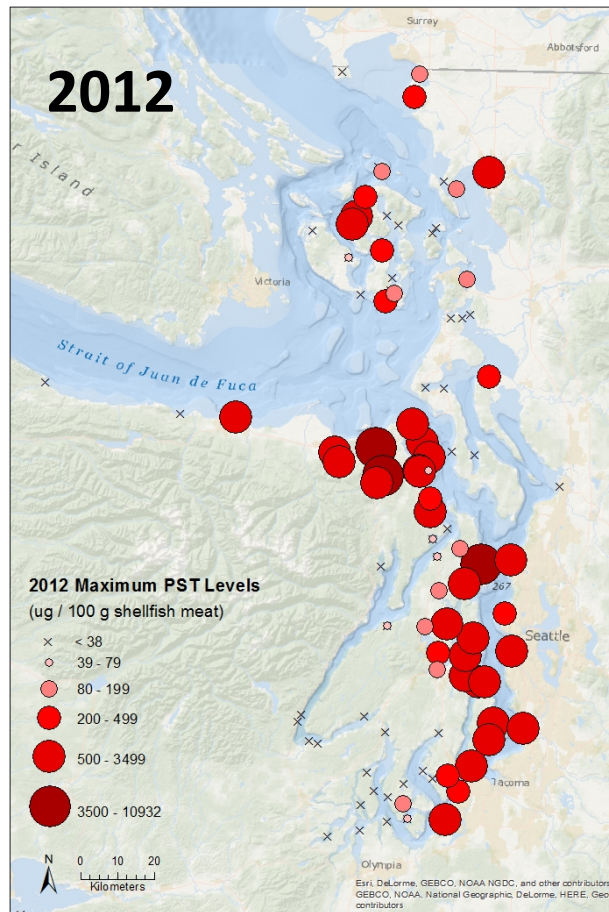
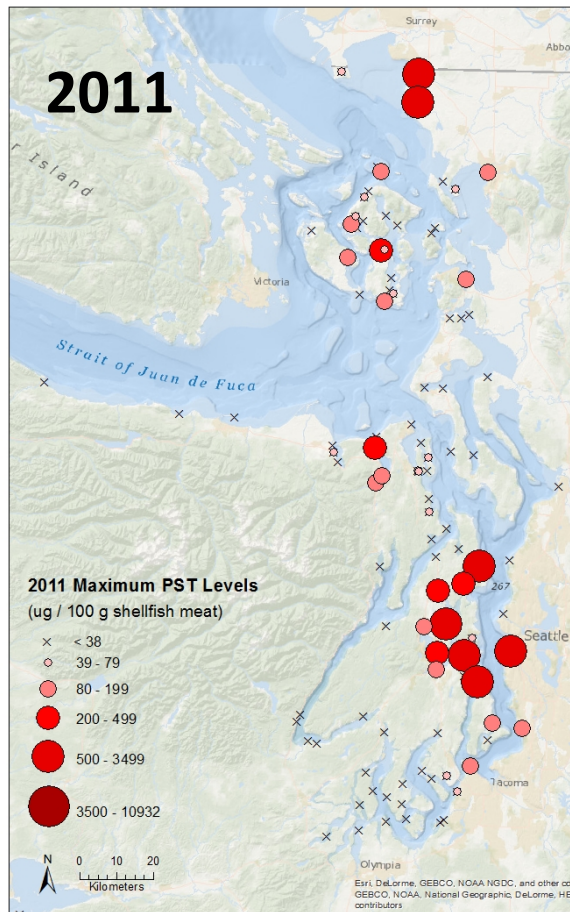
Where are cysts located?

PS-AHAB



*2005 data from Horner et al. (2011): Harmful Algae

Maximum PST Levels in Shellfish (ug/100 g shellfish tissue)



80 ug/100 g is the closure limit



Data courtesy of Washington State
Department of Health

Quartermaster Harbor *Alexandrium* in water column & PST in shellfish

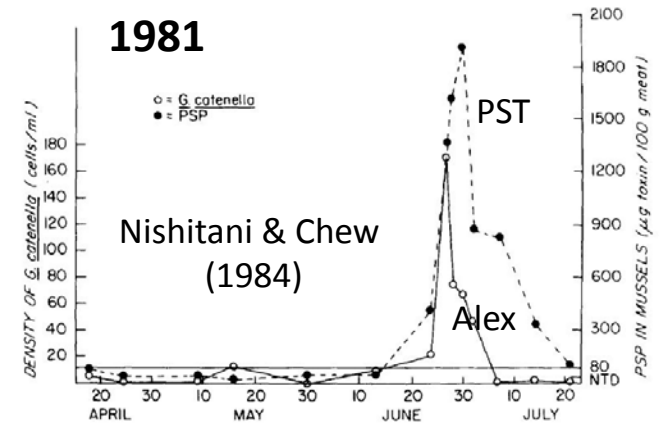


Fig. 3. Changes in PSP in mussels and density of *G. catenella* in afternoon samples at 0.5 m depth, Station DT, April-July 1981.

80 $\mu\text{g}/100$ g is the closure limit

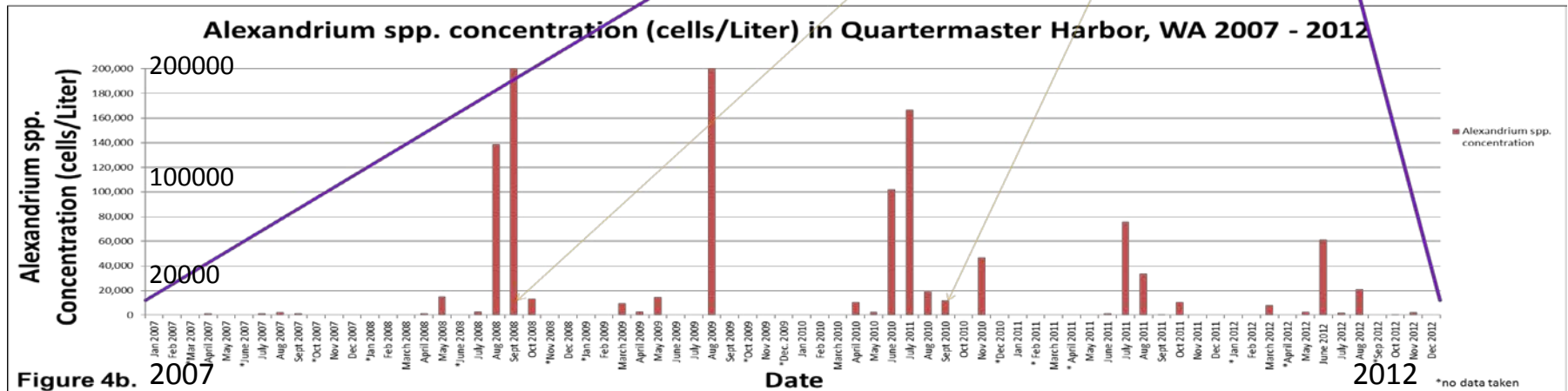
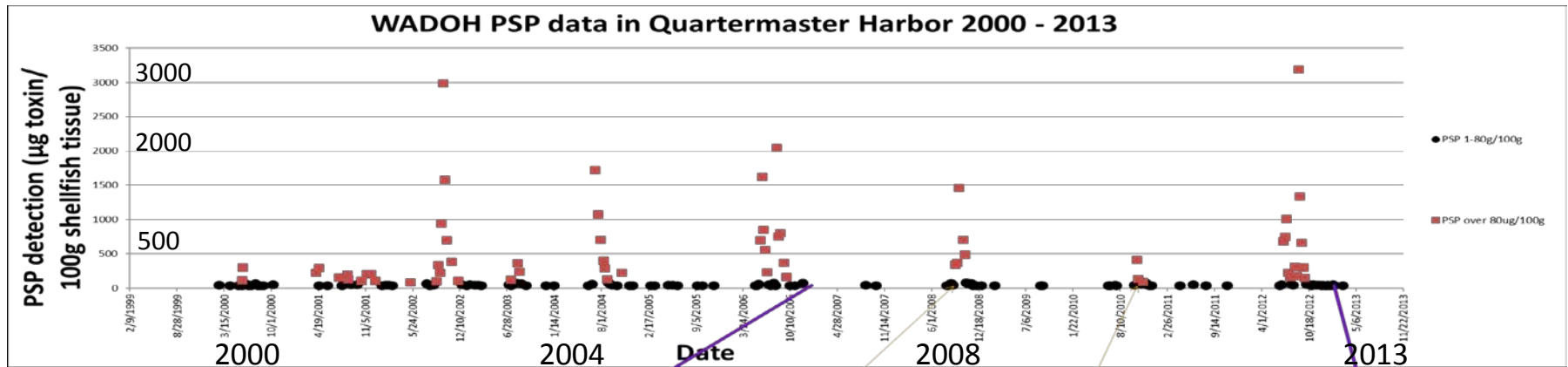
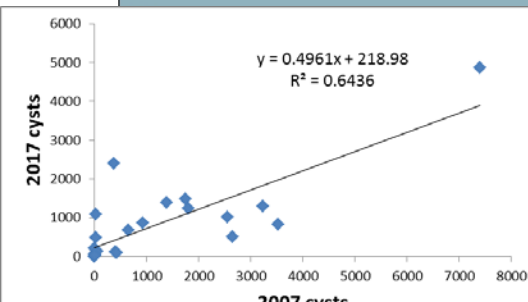
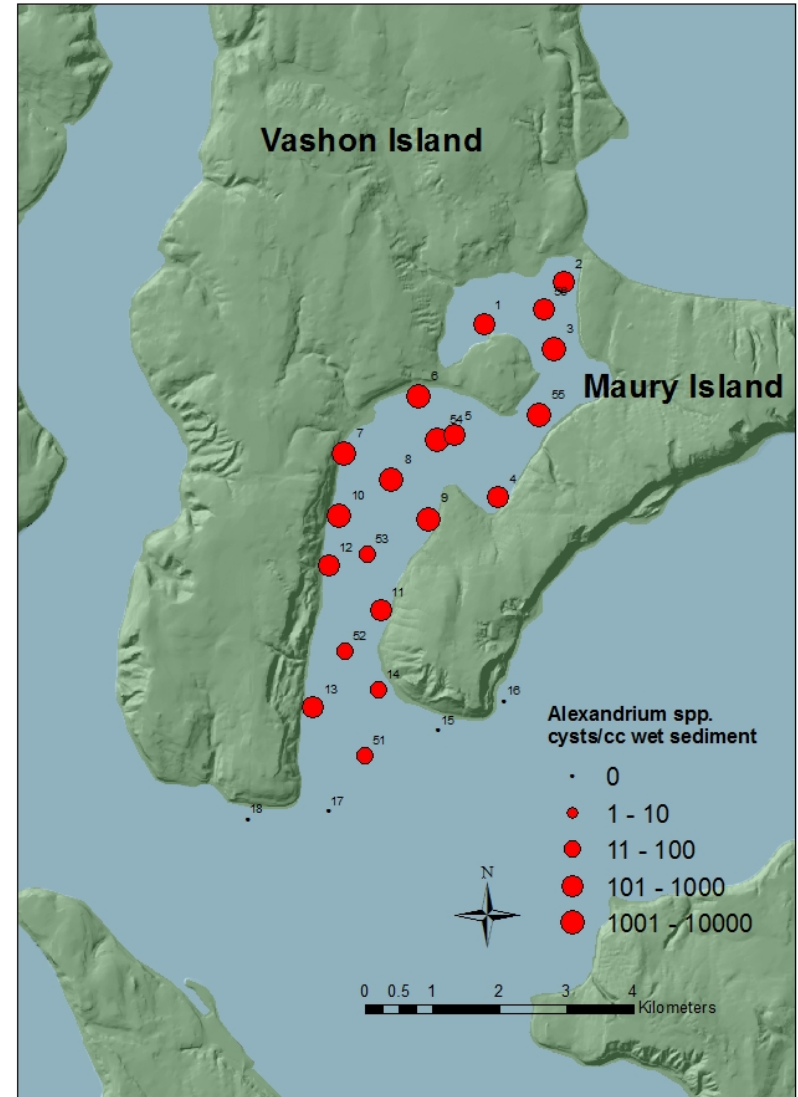
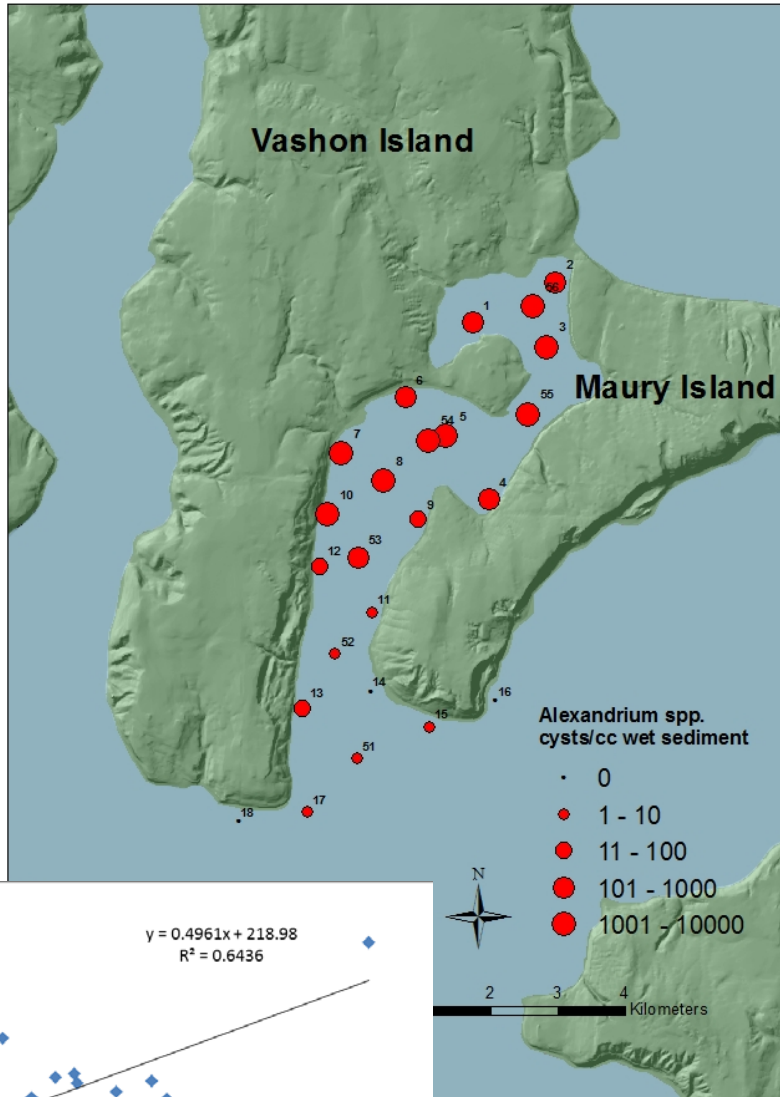


Figure 4b.

Comparison of *Alexandrium* cyst distribution in the surface sediments of Quartermaster Harbor

2007 Quartermaster Harbor Cyst Abundance

2017 Quartermaster Harbor Cyst Abundance



Alexandrium cysts, grain size and TOC down core in

Quartermaster Harbor

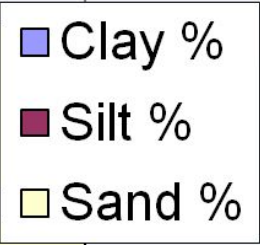
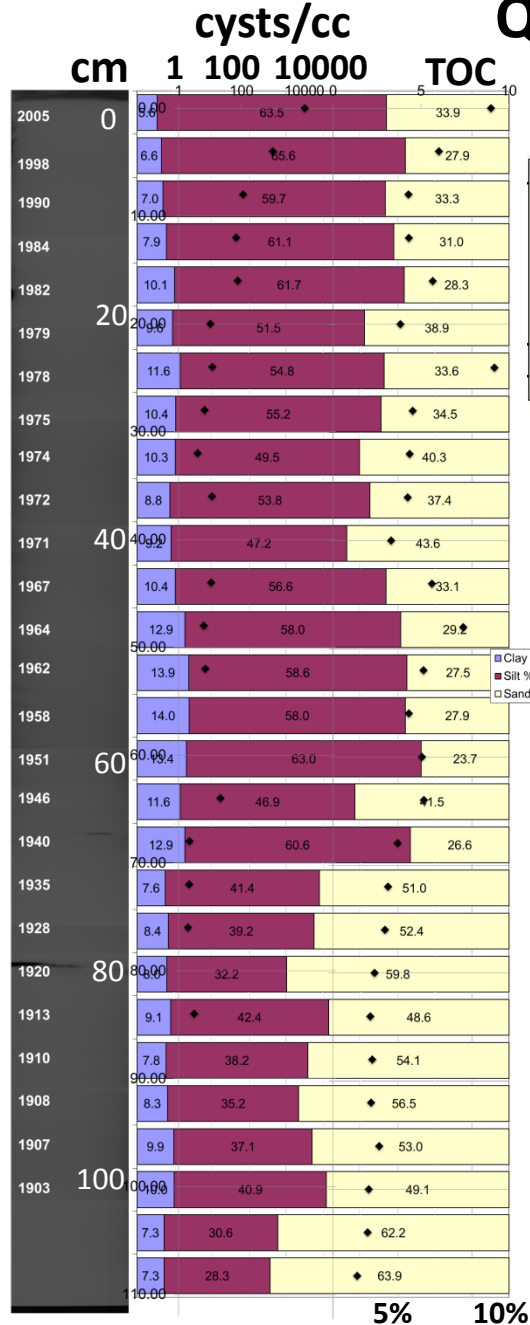
2005

Piston Core

1950

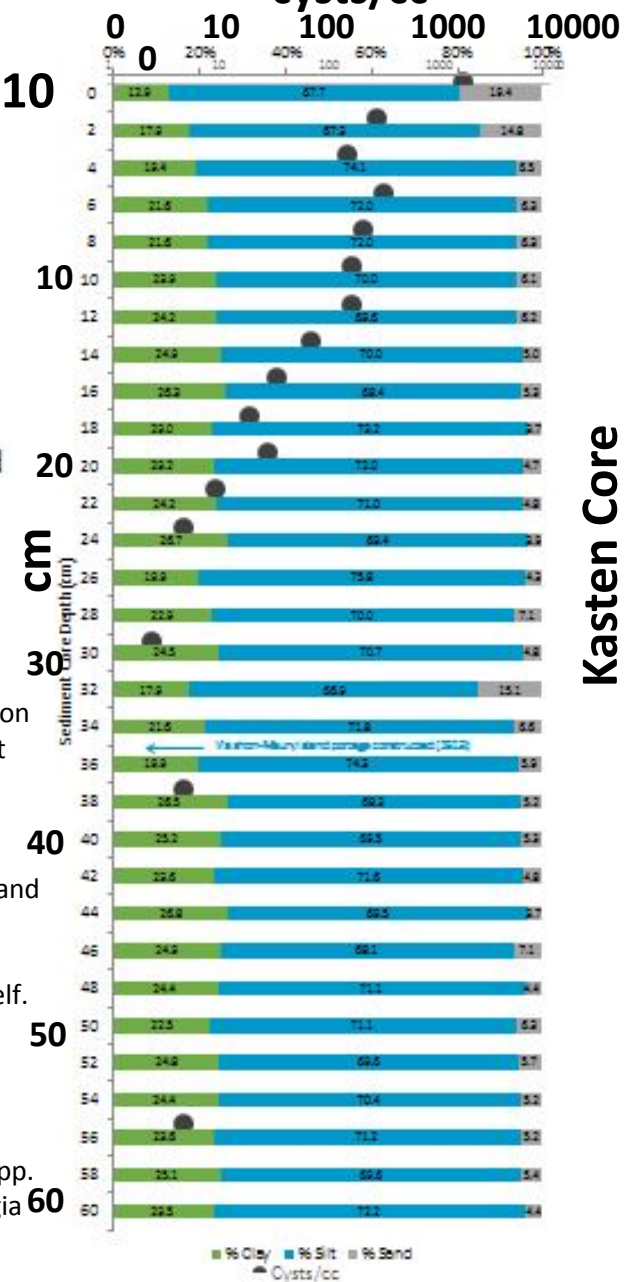
Close portage
1925

1900



2010

Kasten Core



METHODS

Appleby, P.G. and Oldfield. 1978. The calculation of lead-210 analysis dates assuming a constant rate of supply of unsupported 210Pb to the sediment. *Catena* 5: 1-8.

Nittrouer, C.A., R.W. Sternberg, R. Carpenter, and J.T. Bennett. 1979. The use of 210Pb geochronology as a sedimentological tool: application to the Washington continental shelf. *Mar. Geol.* 31:297-316

Yamaguchi, M., S. Itakura, I. Imai and Y. Ishida. 1995. A rapid and precise technique for enumeration of resting cysts of *Alexandrium* spp. (Dinophyceae) in natural sediments. *Phycologia* 34:207-214.

WHY?

- Shallow incubator bay (light)
- The right water properties (temperature & stratification)
- Long residence time

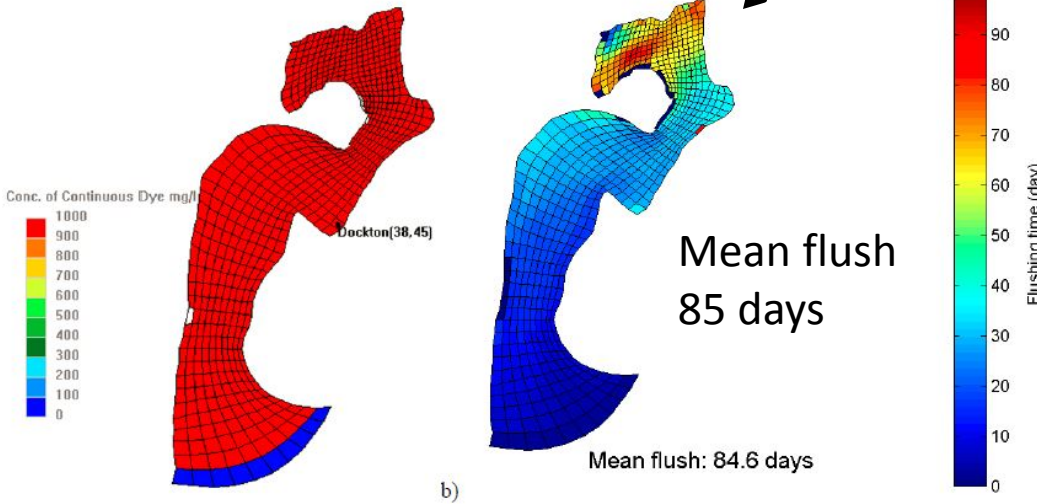
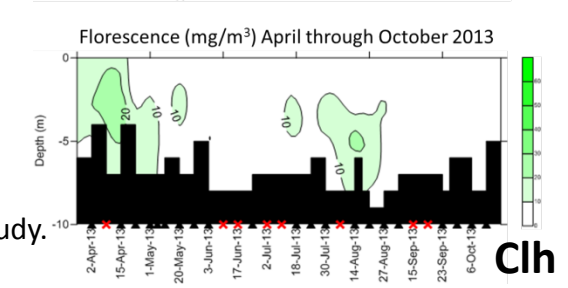
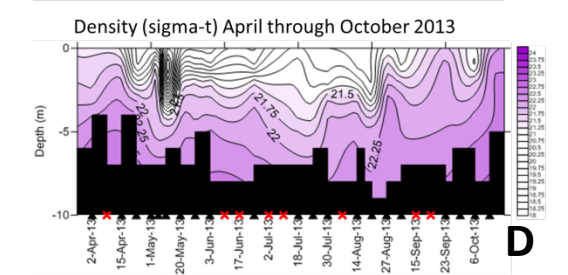
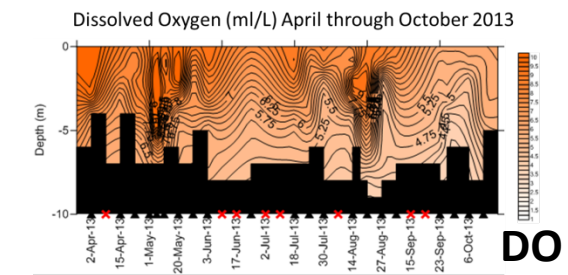
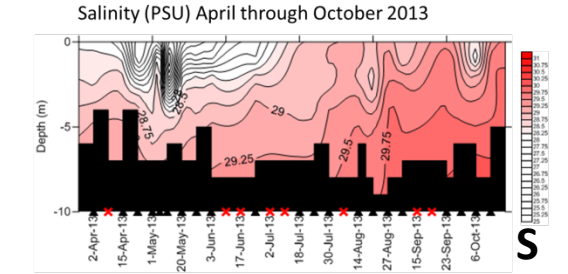
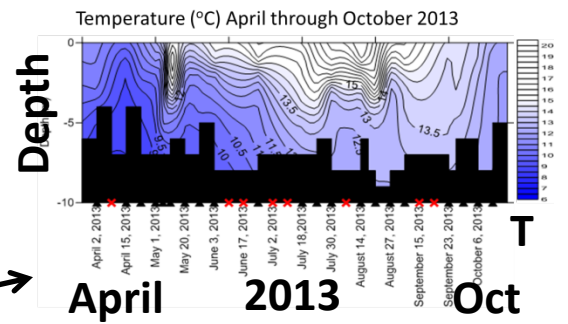
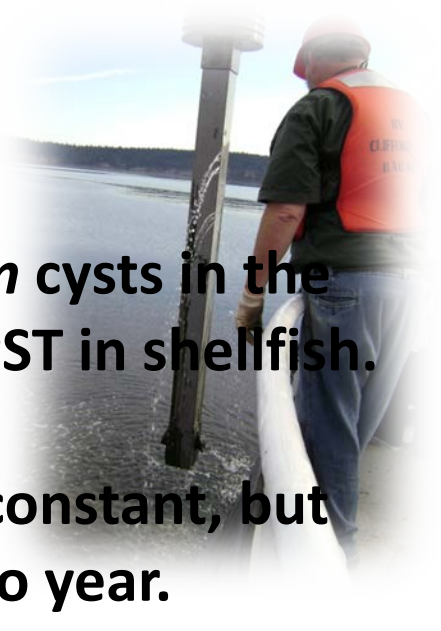


Figure 19. Predicted flushing times for the inner bay based on e-folding time of flushed dye tracer after being initialized uniformly throughout the model (October 2009 shown).

Summary

- Quartermaster Harbor is a hotspot for *Alexandrium* cysts in the sediment, vegetative cells in the water column & PST in shellfish.
- Cyst distribution pattern in the bay remains fairly constant, but the absolute abundance of cysts varies from year to year.
- Factors contributing to making this bay *Alexandrium* heaven are that it is a shallow incubator bay with the right water properties and long residence time.



Questions?

Thanks

- PS-AHAB
- Washington State Department of Health
- A variety of funding agencies
- Captains & Crews of multiple vessels
- Many, many UWT Students



thou all-destroying but unconquering cell
from hell's heart I stab at thee
for hate's sake I spit my last breath at thee
Sink all coffins and all hearses to one common pool!
and since neither can be mine, let me then tow to pieces,
while still chasing thee, though tied to thee, thou damned cell!

PS-AHAB

All that most maddens and torments;
all that stirs up the lees of things;
all that cracks the sinews and cakes the brain;
all the subtle demonisms of life and thought;
all evil, to crazy Ahab, were visibly personified,
and made practically assailable in Ahab.
He piled upon the cell's thecal plates
the sum of all the general rage and hate
felt by his whole race from Adam down;
and then, as if his chest had been a mortar,
he burst his hot heart's shell upon it.