An unprecedented coastwide toxic algal bloom linked to anomalous ocean conditions

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...and a little bit more about monitoring



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West Coast Harmful Algal Bloom (Pseudo-nitzschia)



- Breadth Channel Islands to Aleutian Islands
- Length Longest lasting (mos)
- Levels Highest toxin concentrations ever measured in anchovies
- "Super" Pseudo-nitzschia large chains, chloroplasts bulging



Dense blooms May-June 2015







- "Super" *Pseudo-nitzschia* long chains, chloroplasts bulging
- Like a lab culture, few other phytoplankton



Impacts of North Pacific Coast Domoic Acid Event



Toxic Algal Bloom Spurred by Pacific 'Warm Blob" Wreaks Havoc for West Coast Crab Fisherman



Dungeness Crabbers Hit Hard By Algae Bloom On Washington Coast



Dabber Tom Petersen would rather have his crab pats on the floor of the Pacific, but a taxic algae bloom h anomated health afficials to close the youth Washington coast to commercial and recreational crabbing.

Dungeness crab fisheries closed in multiple states. West coast crab fishery valued at \$180 million USD



Anchovy and sardine fisheries health advisory in California due to high toxins

Closure of razor clam fishery ~\$23 million USD lost in lost spending

Seizuring sea lion (first ever observed on WA coast) Many sea lion, seal mortalities in Monterey Bay

Blob water came to the coast in Sept 2014 – March 2015





"The new normal" Highly toxic, widespread blooms in spring?





Preceding the Bloom was the "Blob"



- Unusually warm SST resulted in drought, low snowpack
- Ocean temperatures ~3°C above normal.
- The blob was 1000 miles long and 300 ft deep
- Nutrients (N) became depleted within the blob
- An "incubator" for toxic algae

What does the future hold? Toxic Pseudo-nitzschia & climate



Razor clam DA shows a lag to growth potential with peaks in El Niño years or with lag (yellow)

New statewise advisory for razor clam consumption



Contents lists available at ScienceDirect

Harmful Algae

journal homepage: www.elsevier.com/locate/hal



HARMFUL

The association between razor clam consumption and memory in the CoASTAL cohort

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"There is a possible association between long-term, low level exposure to domoic acid through razor clam consumption and memory functioning"



What made 2015 unusual?



- Spring timing of large-scale toxic *Pseudo-nitzschia* bloom
- Simultaneous coastwide closures of shellfish harvest
- Unusual delivery of *P. australis* due more northward transport
- The Blob as an offshore incubator for toxic cells
- NO₃ concentrations decreased in Blob water
- Surge uptake of upwelled nutrients by *P. australis* after they were delivered to the coast by storms
- Blob provided a natural experiment to simulate global warming

WARNING ... TOXIC SHELLFISH

SHELLFISH FROM THIS AREA ARE UNSAFE TO EAT DUE TO PARALYTIC SHELLFISH TOXIN. DO NOT EAT CLAMS, OYSTERS, MUSSELS OR SCALLOPS.









Seafood Safety – Example Monitoring Programs

Harmful Algae

- Produce **biotoxins** that can accumulate in filter-feeding shellfish during blooms
- Consumption of contaminated shellfish causes human poisoning



Seafood safety needs

- Monitoring for harmful algae, toxins
 & environmental parameters
- 2. Rapid & effective data communication



3. Outreach & education



Monitoring



- 1. Regulatory testing required, e.g. mouse bioassay
 - use of animal system, large infrastructure, time intensive
- 2. But -- regulatory testing may not always satisfy needs
- 3. Need an efficient way of establishing when & where seafood may be toxic
 - monitoring presence of toxic cells
 - measurement of toxicity using rapid, simple tests
 - long-term data collection leading to prediction

Next we show an example of a cost-effective way to identify where & when seafood is toxic which complements the standard regulatory approach

HAB early warning system

Past – test continuously

Expensive, time consuming LAST MINUTE CLOSURES

1. Dig for clams



2. Test clams at Health Departments



HAB early warning system

Past – test continuously

Expensive, time consuming LAST MINUTE CLOSURES

1. Dig for clams



Present – tiered testing system

Cost & time effective SAFER

1. Collect plankton



2. Look for toxic cells



2. Test clams at Health Department



3. Test for toxin (seawater & clams)



Test clams at DOH



Tiered Monitoring Strategy



Phytoplankton monitoring: SoundToxins and ORHAB



Partners include N@AA, WA SeaGrant (co-leads), Taylor, Coast, Penn Cove & Seattle Shellfish, Tribes, UW, WSU, Evergreen College, volunteers

Personnel and Collaborators







The 3 big bad HABs



Images from Florida Fish and Wildlife Conservation Commission; NOAA CORIS; Oceanography Vol.18, No.2, June 2005: *Images courtesy* NOAA Fisheries, Seattle, WA, the Center for Integrated Marine Technology, T. Moita, and F. Figueiras.

www.soundtoxins.org



Dinophysis Detailed Map Click here to view in a larger map

Red: Present with cell count above 1,000 cells/L. Yellow: Present with cell count between 1-999 cells/L. Green: Absent. Grey: April - October: not sampled for more than 15 days. November - March: not sampled for more than 30 days.