Targeted monitoring for HAB early warning

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West Coast Harmful Algal Bloom (Pseudo-nitzschia)

TUESDAY, JUNE 16, 2015

The Seattle Times

WINNER OF 10 PULITZER PRIZES

PARTLY SUNNY
High, 72. Low, 52. > 88
seattletimes.com/weather

$1.00

Toxic algae bloom might be largest ever

SHELLFISH HARVESTS SHUT DOWN

High temperatures suspected

Marine biotoxins

Marine biotoxins are produced by microscopic algae. Unlike the bacteria or viruses that can also contaminate shellfish, biotoxins are not destroyed by cooking or freezing. Also, harmful algal blooms usually don't color the water.

The three biotoxins of concern in Washington are:

- **Paralytic shellfish poisoning.** Symptoms include

By SANDI DOUGHTON
Seattle Times science reporter

A team of federal biologists set out from Oregon Monday to survey what could be the largest toxic algae bloom ever recorded off the West Coast.

The effects stretch from Central California to British Columbia, and possibly as far north as Alaska. Dangerous levels of the natural toxin domoic acid have shut down recreational and commercial shellfish harvests in Washington, Oregon and California this spring, including the lucrative Dungeness crab fishery off Washington's southern coast and the state's popular razor-clam season.

At the same time, two other types of toxins rarely seen in combination are turning up in shellfish in Puget Sound and along the Washington coast, said Vera Trainer, manager of the Marine Microbes and Toxins Programs at the Northwest Fisheries Science Center in Seattle.

"The fact that we're seeing multiple

BRITISH COLUMBIA
Victoria
Neah Bay
Bellingham
Everett
Seattle
Tacoma
Olympia
Kalaloch
Ocean Shores
WASHINGTON
Long Beach
Astoria
Portland
Pacific City
Waldport
OREGON
Coos Bay
Brookings
Crescent City
Eureka
CALIFORNIA

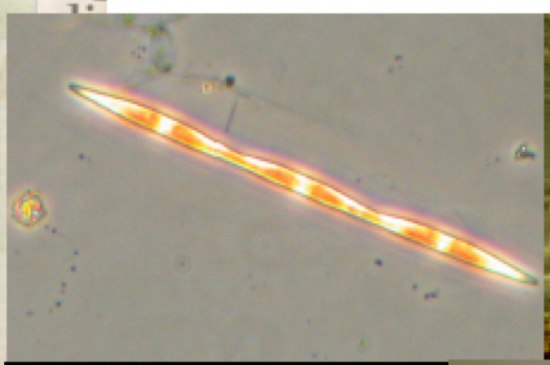
Closures of Puget Sound beaches frequently change. Check State Department of Health for latest conditions. doh.wa.gov

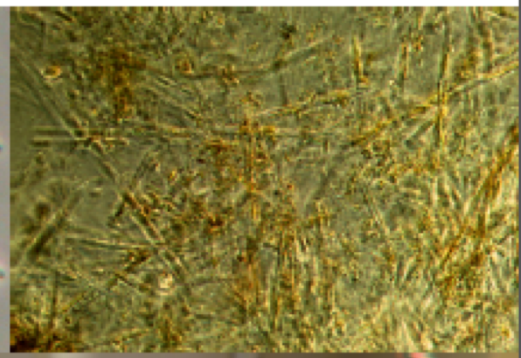
Closed for all recreational shellfish harvesting including clams, geoduck, scallops, mussels, oysters, snails and other invertebrates

The state of California closes beaches to recreational mussel harvesting every year in the spring and summer.

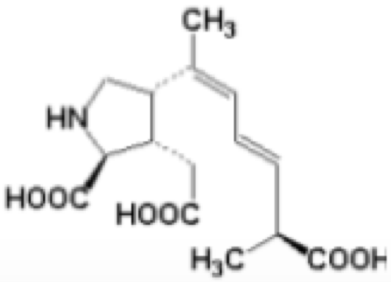
The California Department of Public Health is advising consumers to not eat recreationally harvested mussels, clams, anchovy, sardines, or the internal organs of crab from Monterey and Santa Cruz counties due to dangerous levels of domoic acid.

- 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

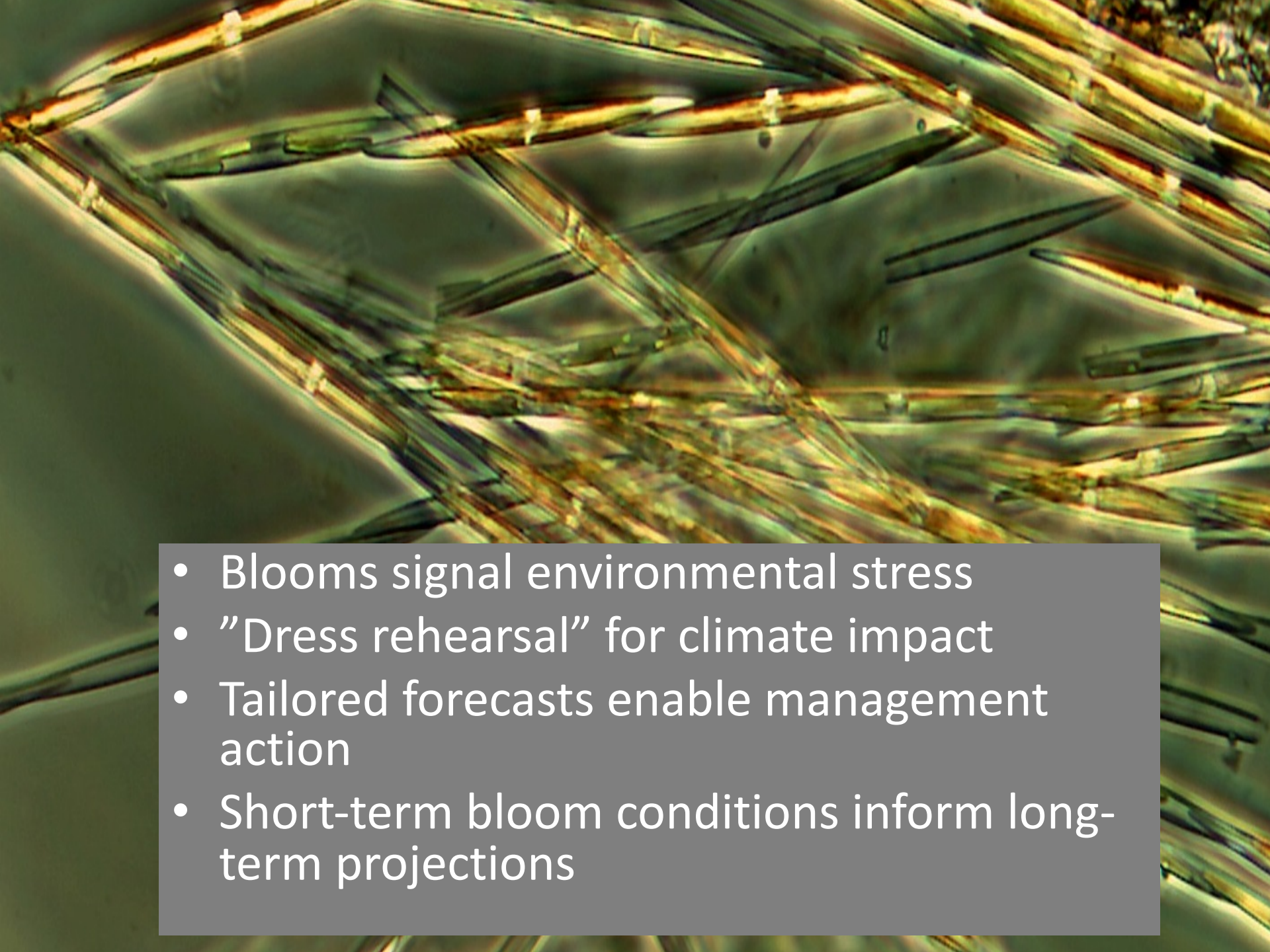




Domoic acid

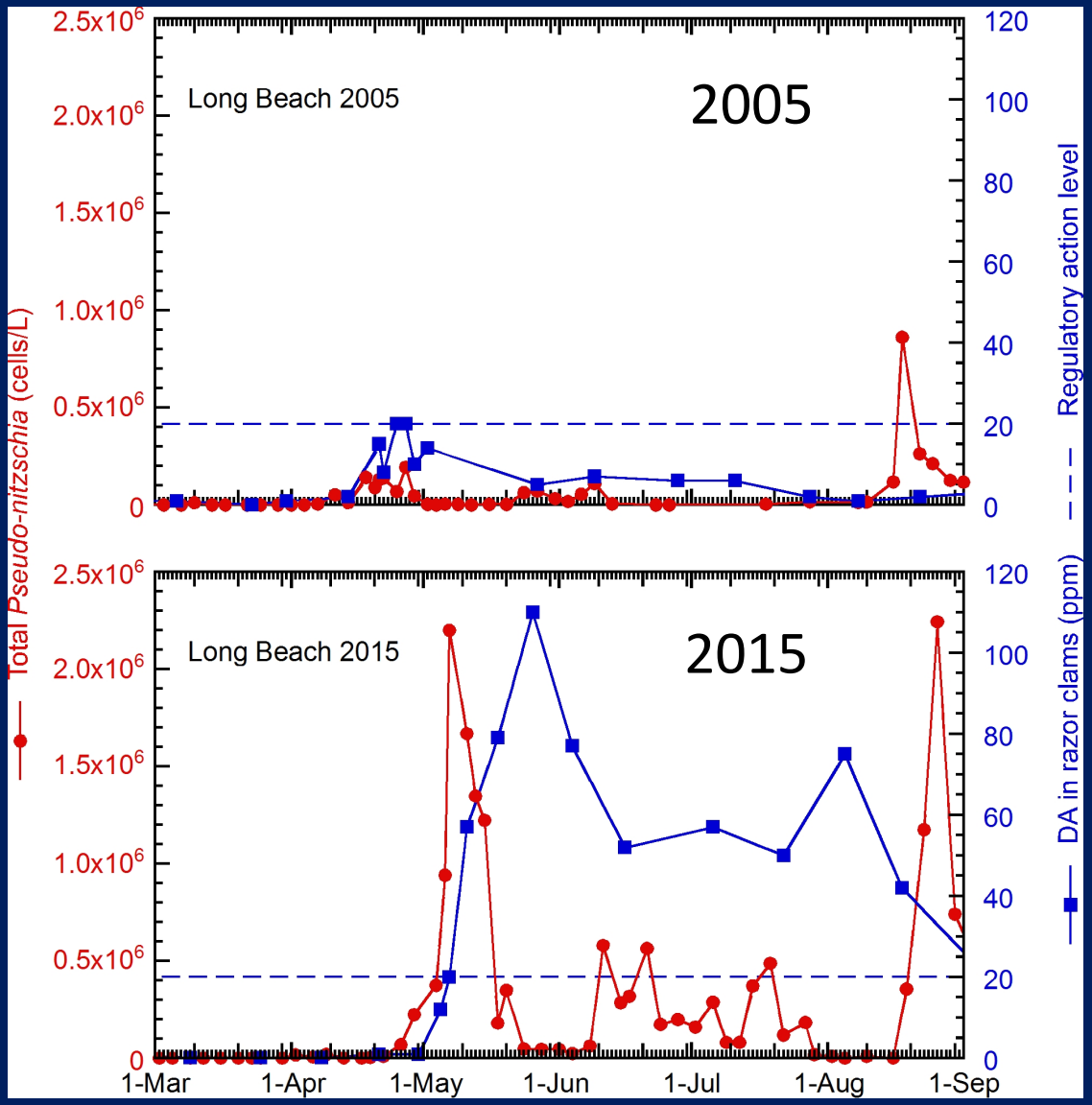


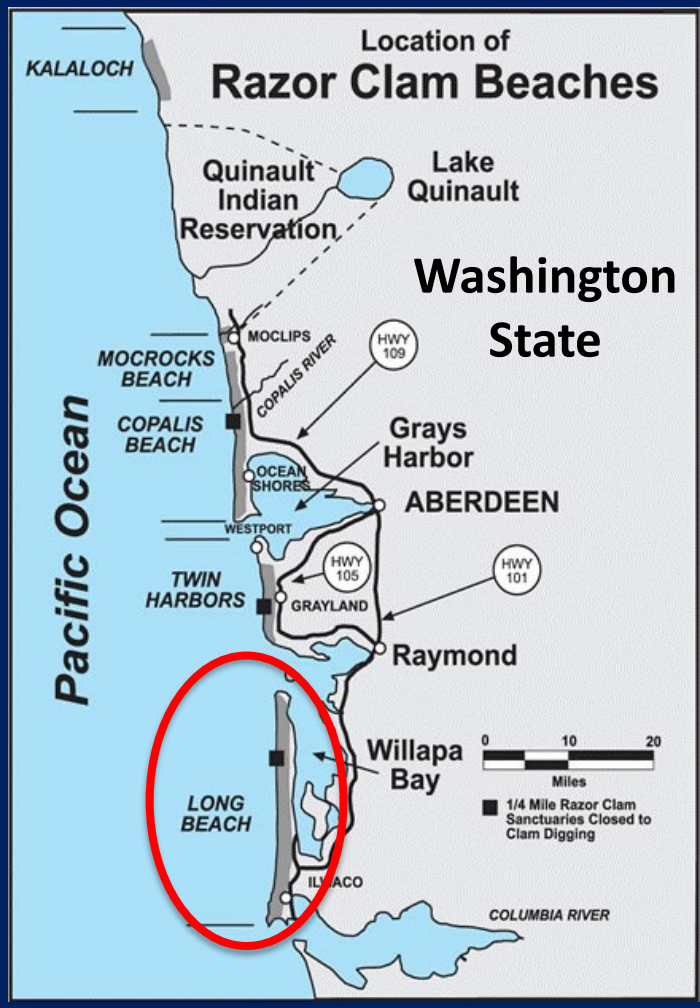
Clogged Bongo nets –
June 25, 2015 Sta. Barbara Channel



- Blooms signal environmental stress
- ”Dress rehearsal” for climate impact
- Tailored forecasts enable management action
- Short-term bloom conditions inform long-term projections

“The new normal”
Highly toxic, widespread blooms in spring?





Impacts

Closure of razor clam fishery
~$7 million lost in WA State alone

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

Courtesy of Vera Trainer (NWFSC)

Dungeness Crabbers Hit Hard By Algae Bloom On Washington Coast

By ASHLEY AHEARN • 18 HOURS AGO

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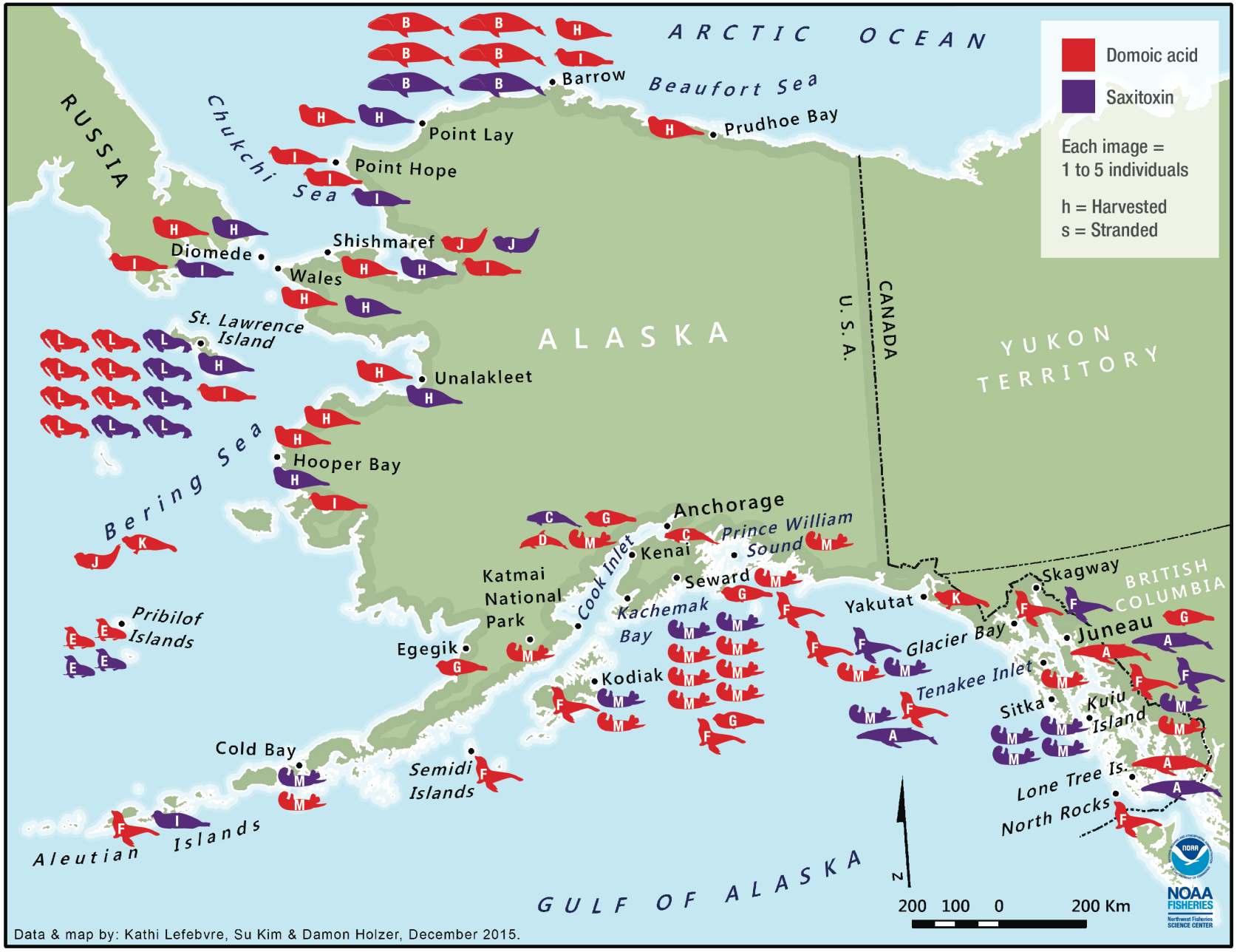
Dungeness crab fisheries closed in multiple states. WA crab fishery valued at $84 million

Algal toxins were detected in 13 species marine mammals from Southeast Alaska to the Arctic Ocean during 2004 to 2013



A Humpback whales (s)

B Bowhead whales (h)

C Beluga whales (s)

D Harbor porpoises (s)

E Northern fur seals (s)

F Steller sea lions (s)

G Harbor seals (s)

H Ringed seals (h)

I Bearded seals (h)

J Spotted seals (h)

K Ribbon seals (h)

L Pacific walruses (h)

M Northern sea otters (s)

Then - 2001

WARNING!

HARVESTING RAZOR CLAMS IS PROHIBITED IN THIS AREA.
Monitored and enforced by Oregon State Police

Due to high levels of naturally occurring toxins,
razor clams in this area are unsafe to eat.

For more information on shellfish harvesting conditions,
call the shellfish hotline at 1-800-448-2474,
or visit the ODA web site at egov.oregon.gov/ODA/

Oregon Department of Agriculture
v.1204

Clam opener canceled due to high toxin count

OLYMPIA — The first razor clam dig of the fall season has been postponed due to elevated levels of marine toxins on Washington's

Beaches affected by the health closure include Long Beach, Twin Harbors, Copalis, Mocrocks and Kalaloch.

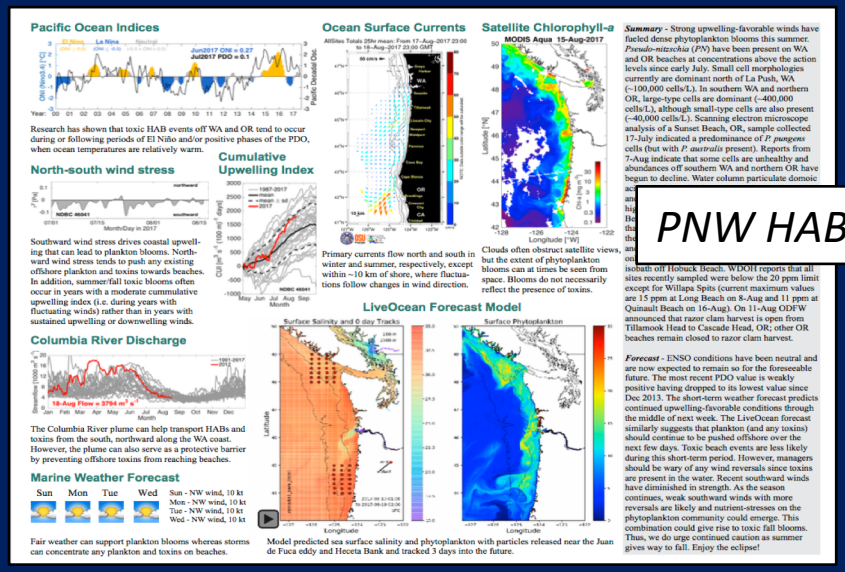
Forecasting Harmful Algal Blooms

Data integration & interpretation:

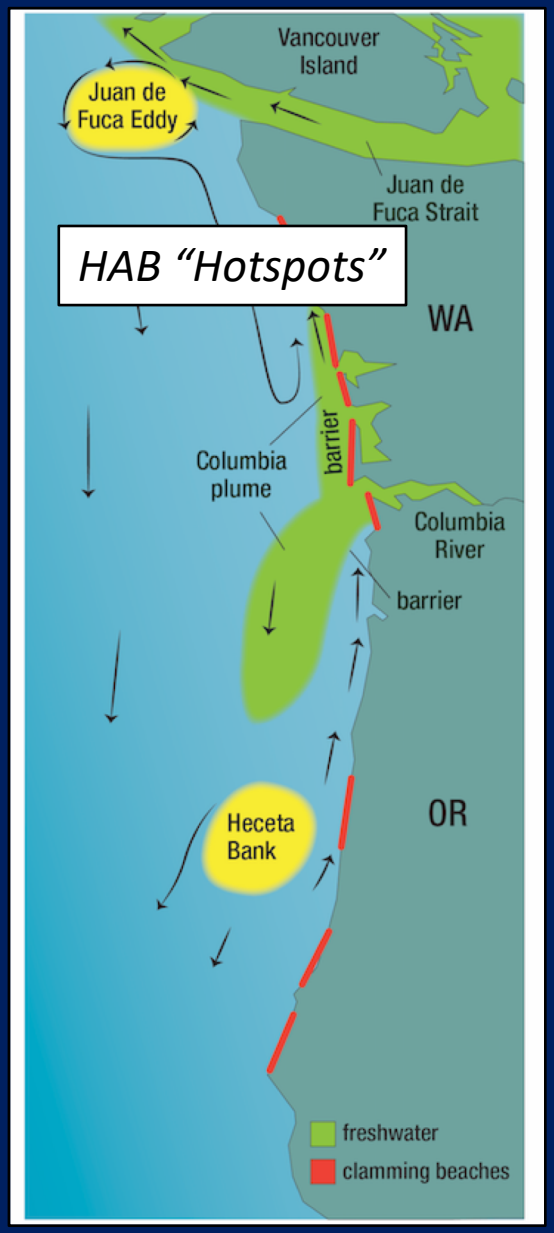
- Toxin & cell monitoring at coast
- Offshore boat sampling at hotspots
- Weather predictions
- Models (cell transport & Columbia River plume)
- Climate change indicators

Facilitates management decisions:

- Selective harvest at safe locations
- Pre-emptive increase in harvest limit
- Filtration or water intake control- aquaculture sites



PNW HAB Bulletin



Now – 2017 to 2019

- *The "PNW HAB Bulletin" gave WDFW shellfishery managers **advance warning** that the window for razor clam harvest opportunity could be quickly closing. WDFW made the highly unusual decision to **increase the daily bag limit from 15 to 25 razor clams per day** for the next razor clam harvest opener –**over $5.3 M realized to the local economy**.*

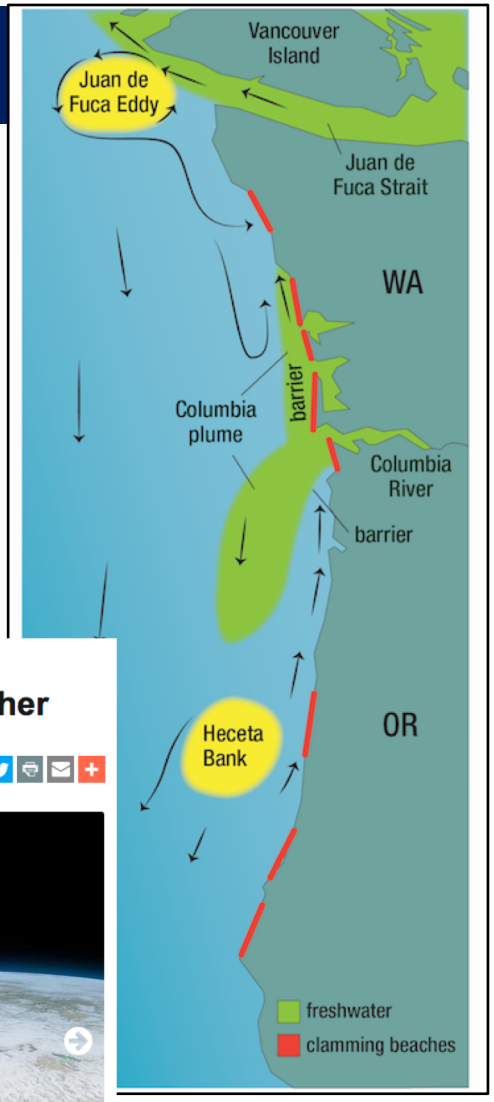
  Dan Ayres, Coastal Shellfish Biologist, WDFW (5/23/17):

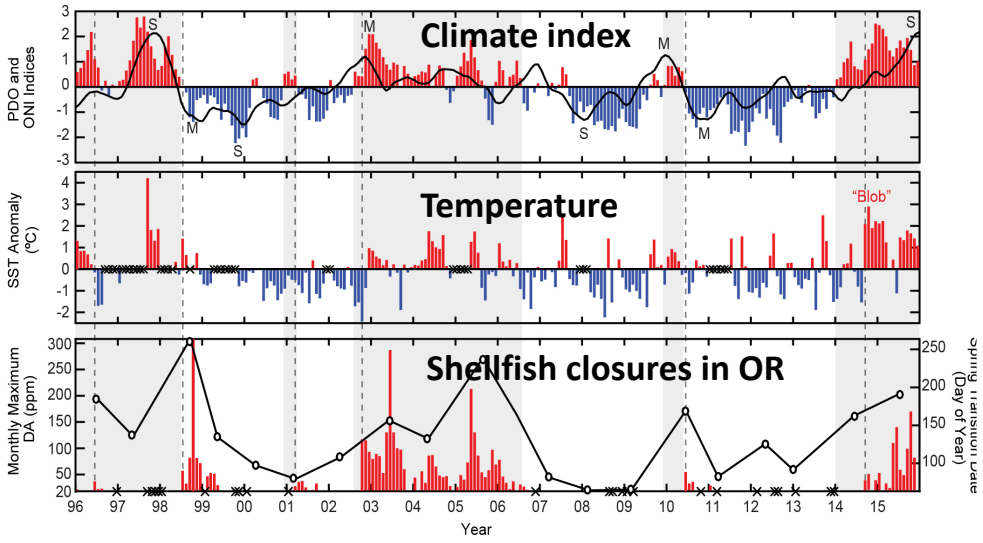
- *"The Long Beach, Washington razor clam opening and increased bag limit was a **boon for OR north coast economies as well**. Astoria businesses sold a lot of digging equipment. "A lot of people were hungry for clams"*

  Matthew Hunter, Shellfish Program, ODFW (5/23/17):

Pseudo-nitzschia (domoic acid)

- Since first identified in 1991, periodic closures of shellfishing
- Severity of annual blooms highly variable but unprecedented coastwide closure in 2015
- Forecasting movement from “hotspots” important
- Linkage to warm ocean (Climate Change)

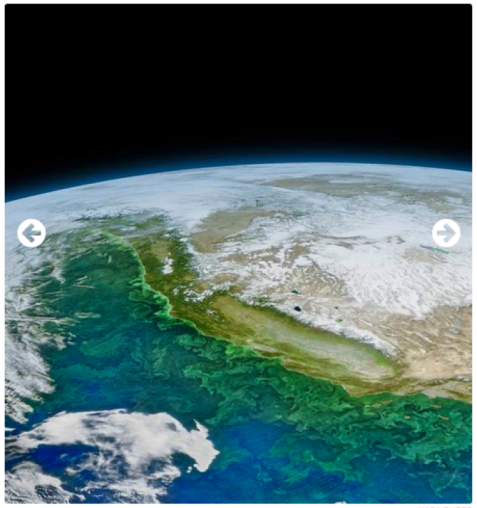




McKibben et al. 2017

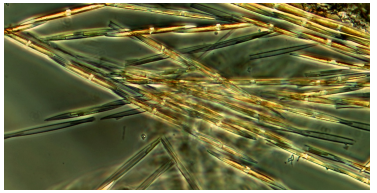
Scientists: Clam toxin, warmer ocean go together

Published on January 17, 2017 2:45PM



NASA PHOTO

Darker green colors near the West Coast of the U.S. reflect blooms of phytoplankton and high algal levels, some of which are toxic.



Phytoplankton monitoring……..early warning SoundToxins and ORHAB

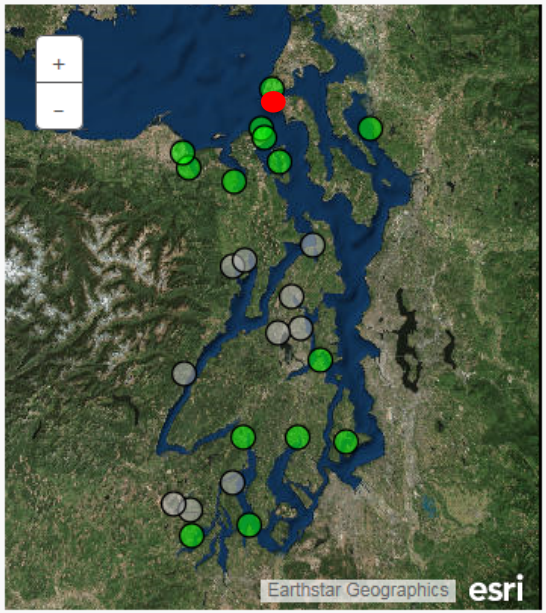
- Weekly phytoplankton monitoring (~30 sites)
- Additional shellfish and seawater toxin analysis during blooms.

Olympic Region HAB (ORHAB) Partnership

SoundToxins Alerts

SoundToxins.org Volunteer Data Entry

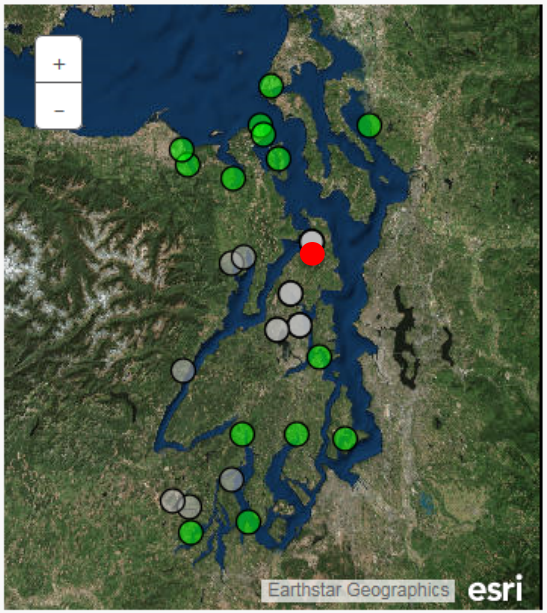
Harmful Algal Bloom Alert Levels



***Alexandrium* Detailed Map**

Click here to view in a larger map

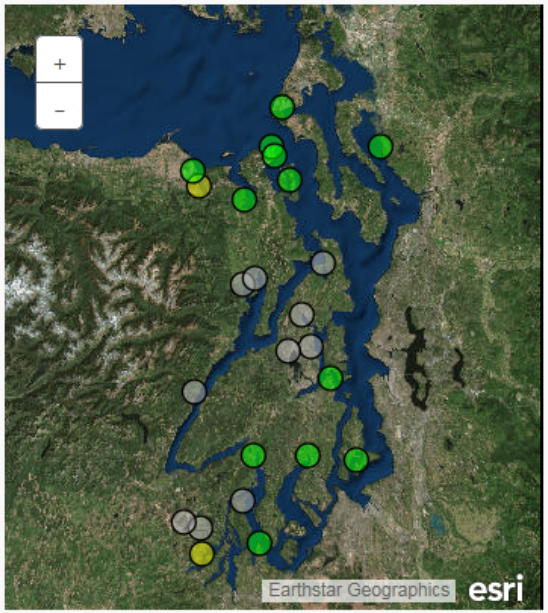
Red: Present with cell count above 100 cells/L.
Yellow: Present with cell count between 1-99 cells/L.
Green: Absent.
Grey: April - October: not sampled for more than 15 days.
November - March: not sampled for more than 30 days.



***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.



***Pseudo-nitzschia* Detailed Map**

Click here to view in a larger map

Red: Present with small cell count greater than or equal to 1,000,000 cells/L or large cell count greater than or equal to 50,000 cells/L.
Yellow: Present with small cell count below 1,000,000 cells/L and large cell count below 50,000 cells/L.
Green: Absent.
Grey: April - October: not sampled for more than 15 days.
November - March: not sampled for more than 30 days.

New challenges for Washington State

New Shellfish Poison Found In U.S. Waters Caused By Algal Bloom

Mysterious shellfish biotoxin surfaces In Sequim

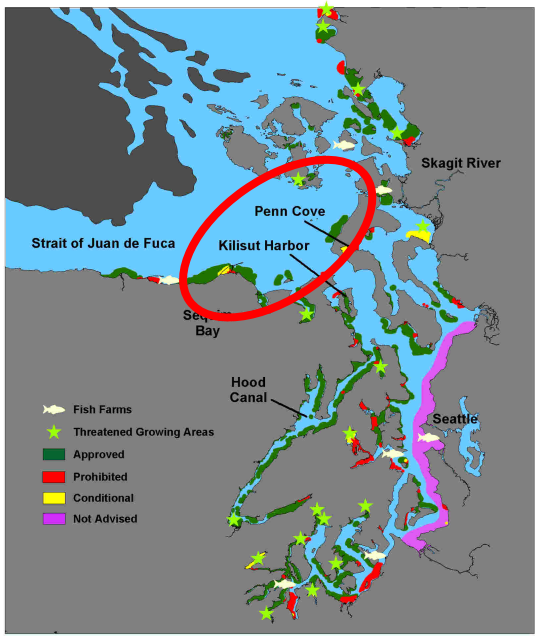
by GARY CHITTIM / KING 5 N

Toxin shuts down Sequim Bay shellfish

A new biotoxin found on the Olympic Peninsula has caused a shellfish closure after an
when they harvested and ate mussels from Sequim Bay.

By Craig Welch
Seattle Times environment reporter

Diarrhetic shellfish poisoning June 2011



Domoic acid closures Puget Sound 2003 & 2005

NW Lawmakers Urge Quick Action To Resume Shellfish Trade

May 29, 2014 | AP

CONTRIBUTED BY:
AP

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Twitter 0
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A geoduck farm near Totten Inlet, Washington.

Ban of US shipment of geoduck to China Dec 2013

FIRST CONFIRMED CASES OF DSP IN UNITED STATES

- Family at Sequim Bay State Park – June 29th, 2011
- Shellfish harvest closures implemented in early August
- Led to recalls of clams and oysters and subsistence harvest closure
- 60 illnesses in British Columbia

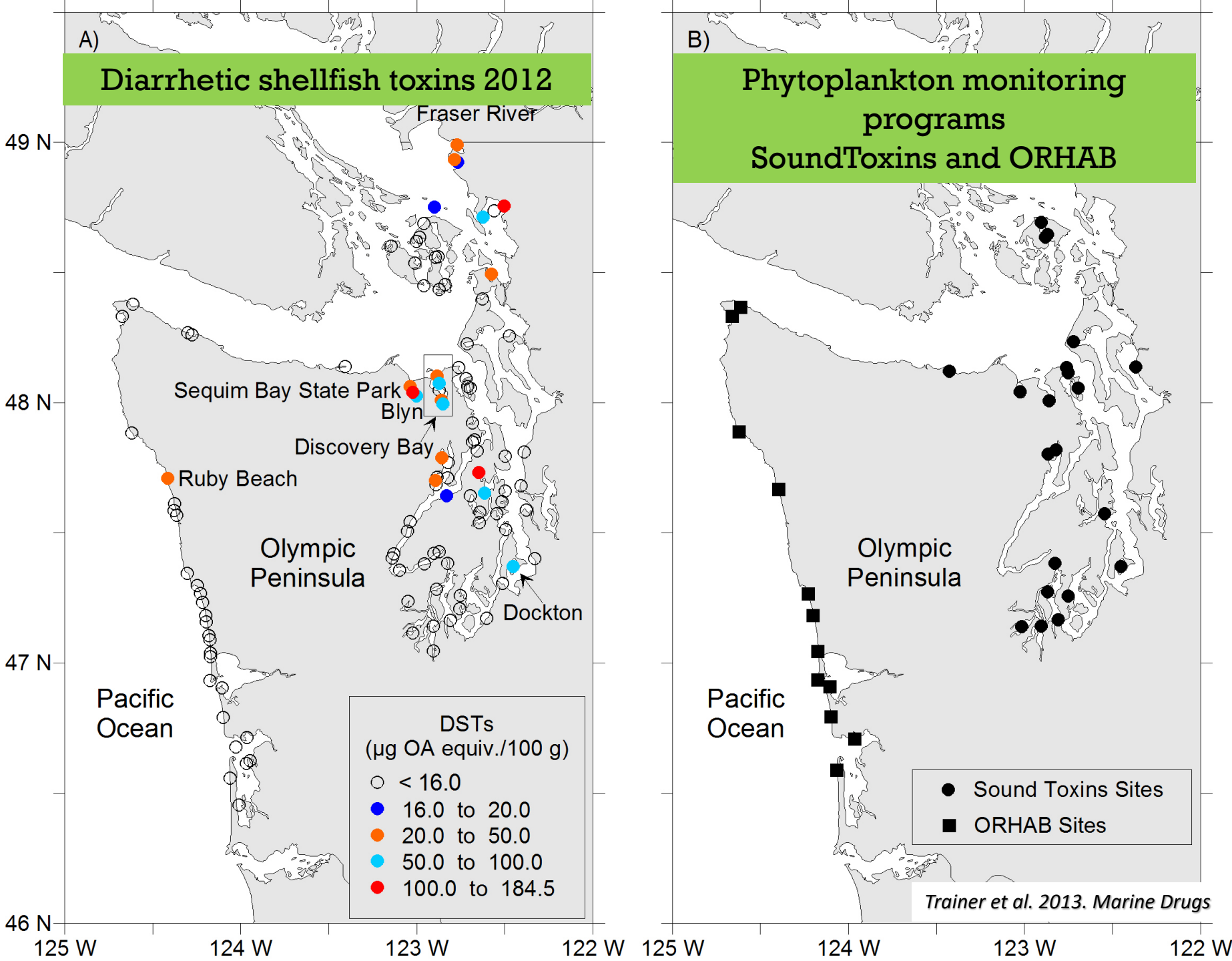
Photo courtesy of KUOW, Seattle

DSP is primarily observed as a mild gastrointestinal disorder.

Nausea, vomiting, diarrhea, and abdominal pain accompanied by chills, headache, and fever.

Onset of the disease may be as little as 30 minutes and up to 2 to 3 hours after ingestion.

Symptoms may last 2 to 3 days and recovery is usually complete with no after effects.


A)
Diarrhetic shellfish toxins 2012
Fraser River
49 N
48 N
47 N
46 N
Sequim Bay State Park
Blyn
Discovery Bay
Ruby Beach
Olympic Peninsula
Dockton
Pacific Ocean
DSTs
(µg OA equiv./100 g)
< 16.0
16.0 to 20.0
20.0 to 50.0
50.0 to 100.0
100.0 to 184.5
125 W
124 W
123 W
122 W
B)
Phytoplankton monitoring programs
SoundToxins and ORHAB
Olympic Peninsula
Pacific Ocean
Sound Toxins Sites
ORHAB Sites
Trainer et al. 2013. Marine Drugs
125 W
124 W
123 W
122 W

Azaspiracids

a relatively newly-described toxin

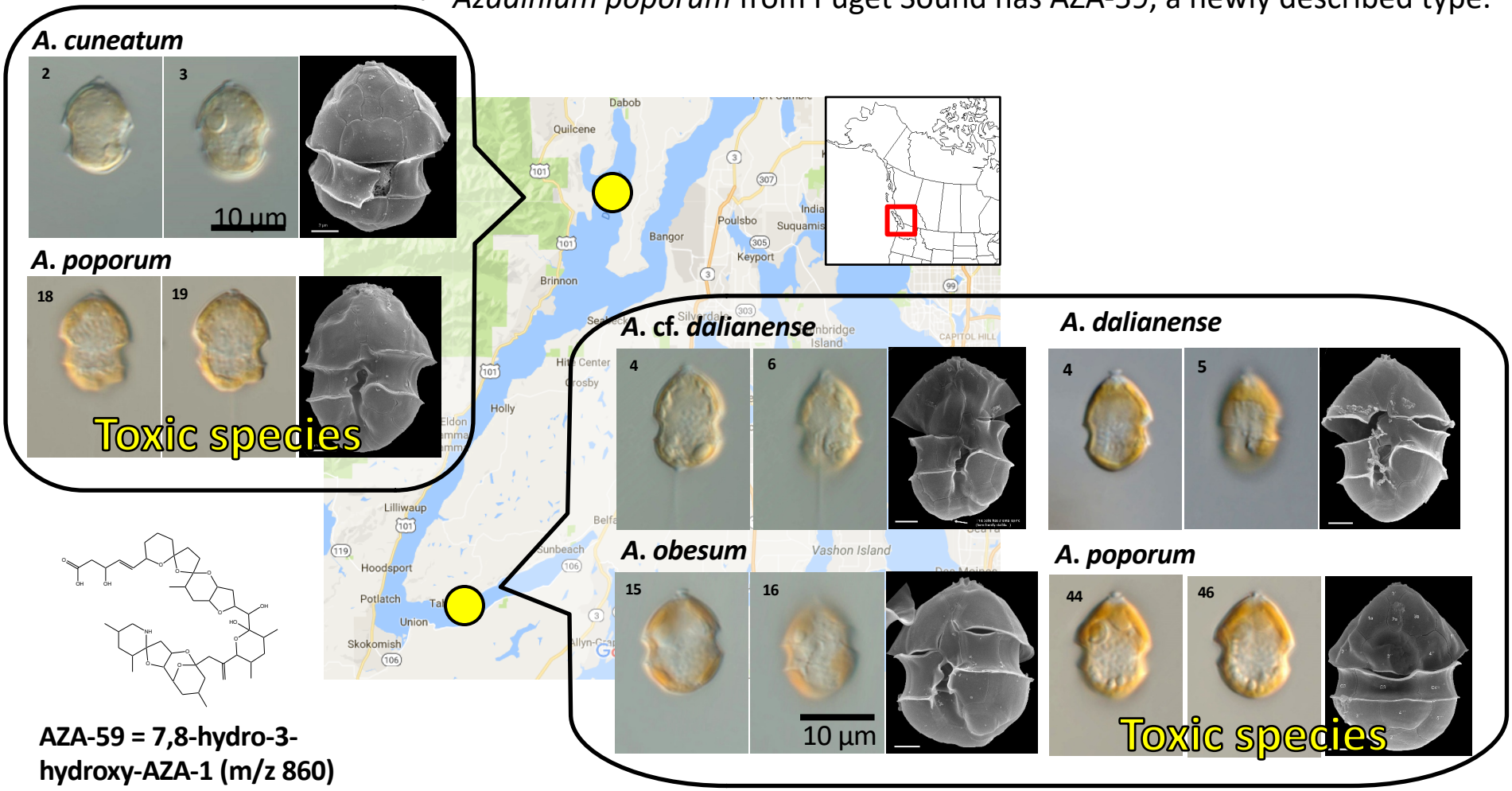
(16 μg/100g regulatory action level)

Background on azaspiracids

- In November 1995, 8 people ill in the Netherlands after eating mussels (*Mytilus edulis*), Although human symptoms such as nausea, vomiting, severe diarrhoea, and stomach cramps were similar to DSP, concentrations of major DSP toxins OA and DTXs were very low.
- Since 1996 several AZP incidents have been identified in Ireland.
- Maximum regulatory levels of AZP toxins in bivalve molluscs, echinoderms, tunicates and marine gastropods (whole body or any part edible separately) are 160 μg/kg.
- Size is ~10 μm – passes through typical phytoplankton nets
- Not regulated in USA

Azadinium isolates from Puget Sound

- Total of 15 strains were established from sediment incubation (Hood Canal).
- *Azadinium poporum* from Puget Sound has AZA-59, a newly described type.



AZA-59 = 7,8-hydro-3-hydroxy-AZA-1 (m/z 860)

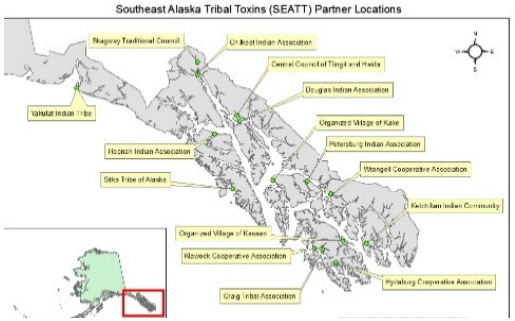
Sediment courtesy Cheryl Greengrove (UW)

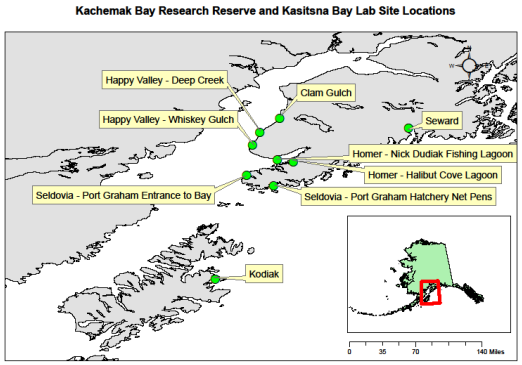
Kim, J. et al. 2017 Harmful Algae

Improving HAB Response

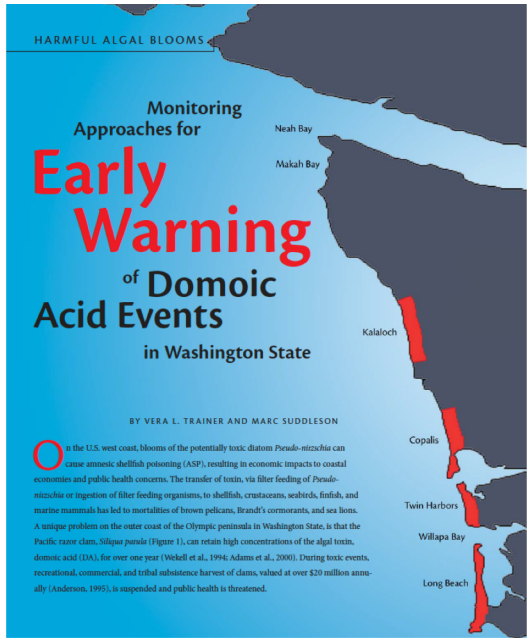
Support and Expand Regional Early Warning Networks

- Engage citizen, tribal and industry monitoring partners
- Monitoring for HAB early warning
- Stakeholders help guide research
- Share toxin analysis capabilities

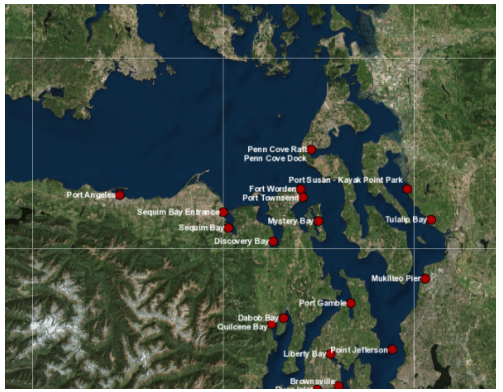




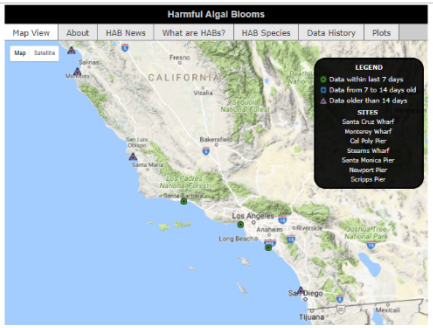
AK - SEATOR & AHAB



WA - ORHAB



WA - SoundToxins



CA - CalHABMAP

Acknowledgements

SEATOR
Culture
Science
Efficiency
Southeast Alaska Tribal Ocean Research

Olympic Region Harmful Algal Blooms
ORHAB PARTNERSHIP

SOUND TOXINS

- NOAA CSCOR Event Response Funding, ECOHAB, MERHAB
- NOAA's Northwest Fisheries Science Center
- WDFW, WDOH, Tribal co-managers
- Cruise volunteers

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE