Restructuring traditional biotoxin monitoring programs for proactive management of new and emerging threats

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What biotoxin in Maine used to mean

- Biotoxin was synonymous with red tide/PSP/saxitoxin
- Decades of experience
- Predictable season from March to October
- Predictable hot spots
- Established sampling stations
- Species specific responses
- HPLC PCOX method provides early warning

What we didn't know…….

- Red tide was easy!

- Use historic information to inform strategy, sample between March and October, monitor phytoplankton, test shellfish, close, open, relax till the following March

……What we know now

- The Gulf of Maine now has PSP and ASP
- Maybe DSP but definitely *Dinophysis norvegicia*

- We also have other HAB species that impact marine organisms but not necessarily human health
- *Karenia mikimotoi* first showed in 2017 and can cause anoxic conditions as well as toxic effects on fish and shellfish
- *Margalefidinium (previously Cochlodium) polykrikoides* first showed in 2016 and can cause anoxic conditions as well as toxic effects on fish and shellfish

Why mention HABs that don't impact human health?

- Guess who the Commissioner calls when the Marine Patrol pilot sees this:

Or when the public sees this on the Portland waterfront:

Questions that are asked

- Telling the Commissioner we only look for HABs that affect human health isn't the "right" answer.
- Will these blooms affect aquaculture farms?
  yes, maybe
- Will these blooms affect wild shellfish resources?
  yes, documented clam kills
- Will these blooms affect fish?
  yes, maybe

No one wants this to happen

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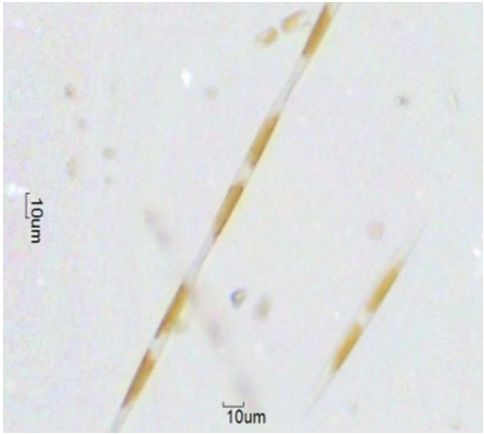
Programmatic changes

- Monitor phytoplankton samples for these species as well as HABs that affect human health
- Alert management and industry when blooms are observed
- Identify/monitor visible blooms
- Monitor DO
- Additional burden on staff resources

Blah blah blah ASP

- *Pseudo-nitzschia* present in the Gulf of Maine since…..forever?
- Toxin present in 2012
- No toxin measured above limit in Maine until 2016
- Identification of *P. australis* in GOM in 2016
- Toxin measured above the limit in 2016, 2017 and 2018



ASP is NOT like PSP

- Decades of experience
- Predictable season from March to October
- Predictable hot spots
- Established sampling stations
- Species specific responses
- HPLC PCOX method provides early warning

PSP

- Nope (3 years and counting)
- Nope (year-round)
- Nope (or maybe?)
- Nope (continually adapting)
- Nope (or maybe?)
- HPLC UV method also provides early warning

ASP

Worst case scenario

- Shellfish seem to exceed the ASP limit quickly when conditions are right
- Testing frequency can't keep up with increases in toxicity
- In 2016 and 2017, closures were implemented after samples exceed ASP limit and recalls were necessary

- Felt like worst case, but really worst case would be an illness outbreak which we avoided
- Recalls work

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Programmatic changes (ASP)

- Year-round phytoplankton sampling
- Qualify cell type (LG v. SM)
- Low LG cell/L trigger
- Presence/absence toxin test on phyto
- Once phytoplankton samples show presence of toxin, meat sampling begins
- Presence of measurable toxin in shellfish triggers precautionary closures

- Protect public health and avoid recalls

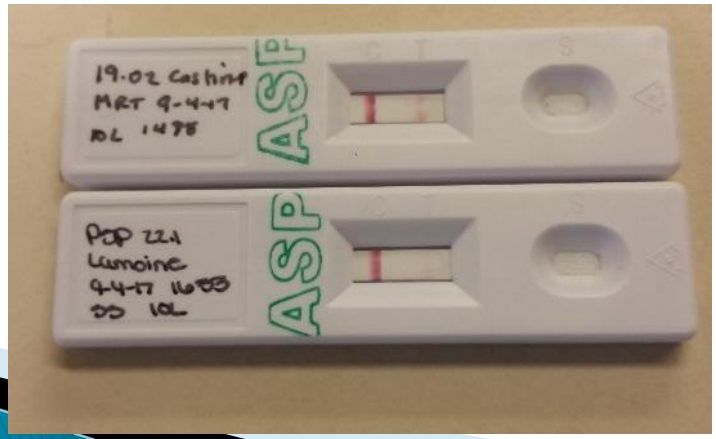
More programmatic changes (ASP)

- Significance of regional mussel closures
- No sampling of non-commercial species
- Biotoxin MOUs (not for LPAs)
- Industry phytoplankton samples required
- Mandatory education for LPAs

- Manage the burden on staff and budget resources

Explaining the phyto component

- We are not regulating on phyto counts
  - That's only allowed in the NSSP MO for *K. brevis*
- Not all *Pseudo-nitzschia* makes toxin and only some species make toxin sometimes
- We use phyto to inform frequency and timing of shellfish meat testing
- If phyto is not making toxin there is no need to do more expensive meat testing

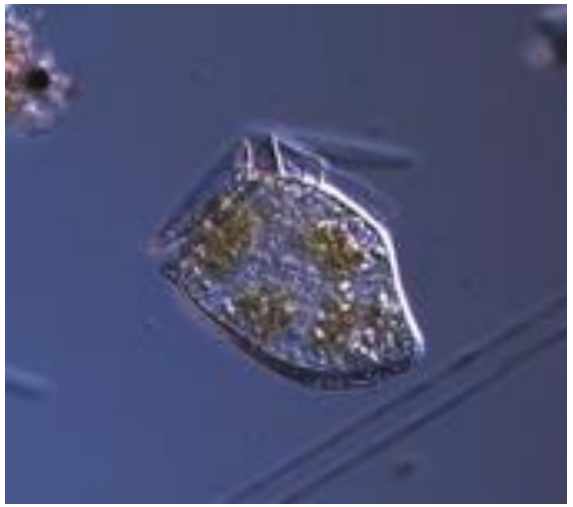


Explaining precautionary closures

- For ASP this seems to be the best way to avoid recalls
- Very disruptive to industry
- Difficult to communicate
- Strains staff and budget resources
- Moving forward:
  - predictable closure periods
  - Increased sample processing capability

And then there's DSP

- Or is there?
- Blooms of *Dinophysis norvegica*
- 2016 and 2018 phosphatase inhibitor assay (PP2A) showed toxicity >regulatory limits
- Approved LCMS method did not show toxicity >regulatory limits



So what do you do?

- Closed area for 3 months
- Closed based on PP2A, reopened with PP2A
- FDA found new toxin that explains conflicting results between methods
- Unknown if new toxin has a human health impact

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Stick with the program

- Going forward use the approved LCMS method
- Supported ECOHAB proposal for investigating this problem
- Collect and purify toxin
- Conduct mouse testing to determine toxic effects