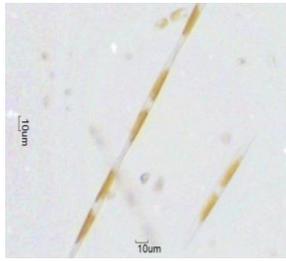
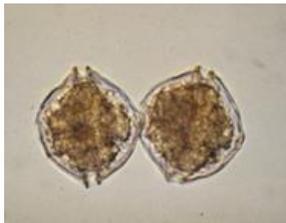


DMR Biotoxin Monitoring Guidance Document for Bivalve Shellfish Aquaculture



Pseudo-nitzschia spp.

domoic acid, ASP



Alexandrium sp.

saxitoxin, PSP

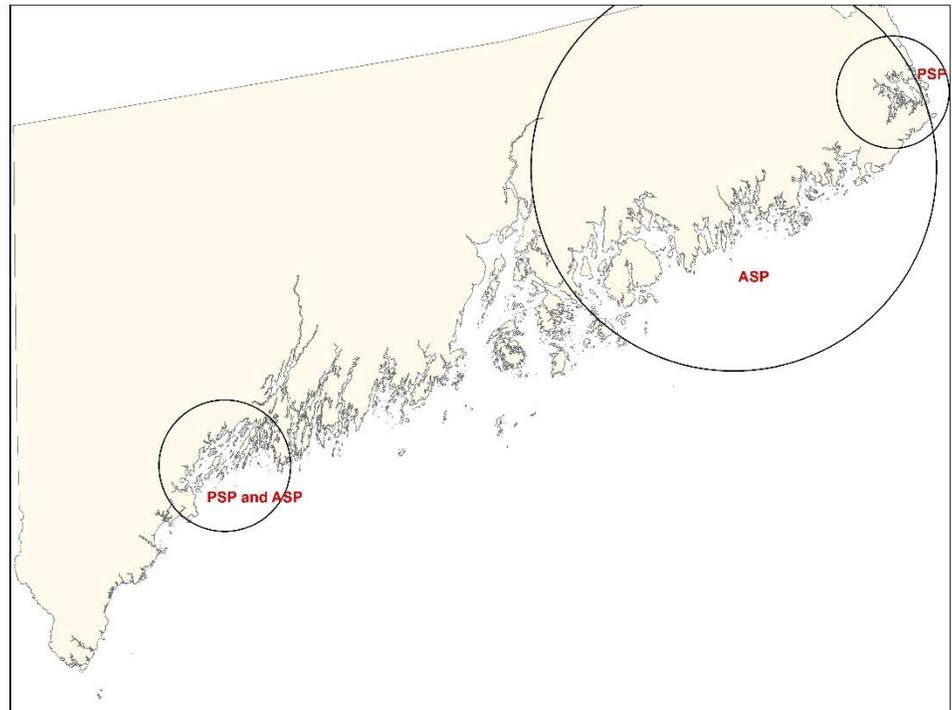


Figure 1. Maine high risk areas for PSP and ASP based on DMR historic bivalve shellfish data.

Introduction

DMR began discussions in 2013 after changes to biotoxin management were initiated to better address high risk bivalve shellfish species and high risk biotoxin areas specifically for aquaculture. Considerations were given to bivalve shellfish with rapid uptake rates (eg. mussel and European oysters) and prolonged toxicity retention (eg. surf clams, razor clams and scallops) to better define a sampling strategy for these species. Memorandums of Understanding (MOUs) provide aquaculture lease (standard and experimental) holders a means for maximum flexibility to harvest product during biotoxin closures and throughout the year based on site location, species harvested, and testing frequency requirements. To effectively manage all biotoxin concerns, DMR has identified areas of high biotoxin risk (Figure 1.) and specific management criteria for safe harvest (Figure 2.). Precautions will be implemented in high risk areas and in some cases may result in limitations on harvest or increased testing requirements. Using weekly, routine monitoring of mussel, oyster and clam sites as the baseline, additional testing required for aquaculture considered outside of DMR routine sampling practices will be submitted to an approved private lab and paid for by industry. Aquaculture species outside of DMR's routine sampling practices include but are not limited to whole or roe-on scallop (bay and Atlantic), razor clam and surf clam (Arctic and surf/hen). Industry members with MOUs may also have the opportunity to initiate additional testing at their expense at a higher frequency than the standard DMR weekly schedule.

Wild harvest exception areas are closed when DMR routine sampling indicates an elevated risk, there is no opportunity for additional, industry funded sampling or MOUs. Biotoxin MOUs and industry funded sampling are also not available for Limited Purpose Aquaculture (LPAs) permit holders.

Background

The degree to which bivalve shellfish become toxic is dependent on exposure to toxic phytoplankton cells in the water column and bivalve shellfish species specific filtration rates. Environmental variables can affect phytoplankton cell abundance resulting in dramatic increases or decreases in a short amount of time. In an active phytoplankton bloom scenario, bivalve shellfish toxicity can reach or exceed regulatory limits within as little as 24 hours. Monitoring phytoplankton abundance and bivalve shellfish toxicity requires a multi-layered, resource intensive strategy that requires full cooperation with industry. DMR implements a robust coastwide phytoplankton and bivalve shellfish monitoring program that responds to real-time results.

Casco Bay and Cobscook Bay are considered high risk areas for Paralytic Shellfish Poisoning (PSP) based on historic DMR biotoxin data. These areas are exposed to annual *Alexandrium catenella* blooms, the phytoplankton responsible for PSP. The toxin produced by this phytoplankton, saxitoxin, can cause paralysis and in severe cases death in humans. There have been documented cases of life-threatening PSP illness caused by the illegal harvest of bivalve shellfish in Maine waters. Closures vary year to year based on the timing and intensity of the blooms. The closure threshold for PSP is 80µg/100g.

Annual blooms of another toxin producing phytoplankton called *Pseudo-nitzschia spp.* have occurred in Casco Bay and in eastern Maine from Cobscook Bay to Frenchman's Bay. The toxin produced by this phytoplankton, domoic acid, is responsible for causing Amnesic Shellfish Poisoning (ASP) because exposure can cause memory loss along with other serious health effects in humans including death. In 2016, bivalve shellfish from Cobscook Bay to Frenchman's Bay first tested positive for domoic acid above the regulatory limit resulting in significant product recalls. Casco Bay first experienced a fall/winter bloom in 2017 that also resulted in toxicity above the regulatory limit. Casco Bay and the area from Cobscook Bay to Frenchman's Bay are considered high risk areas for ASP because toxicity continues to exceed the regulatory limit each year resulting in closures. The closure threshold for ASP is 20µg/g.

Managing High Risk Areas and Species

All areas along the coast during any active bloom season require weekly monitoring, however, high risk areas and high risk species have additional considerations for management. DMR employs a regional management strategy closing mussels, European oysters, surf clams, razor clams, and carnivorous snails from May until the end of the bloom season. The bloom season (PSP and ASP) is unpredictable and changes from year to year generally ending by December. Lease-specific exception areas to the regional and emergency closures for aquaculture lease sites (standard and experimental) require industry to submit a signed MOU to DMR to establish testing requirements. If the aquaculture lease holder wants or requires the services of private lab testing an additional private lab MOU must also be signed and submitted to DMR. These forms can be found on the DMR website:

<https://www.maine.gov/dmr/shellfish-sanitation-management/forms/biotoxin.html>.

High risk species that require industry funded testing include but are not limited to:

1. Whole or roe-on Atlantic scallop: *Plactopecten magellanicus*
2. Whole or roe-on bay scallop: *Argopecten irradians*
3. Surf/hen clam: *Spisula soldissima*
4. Arctic surf clam: *Mactromeris polynyma*
5. Razor clam: *Ensis directus*

The above species pose an additional biotoxin risk because they are slow to eliminate toxins (domoic acid and saxitoxin) due to their capacity to store these toxins within their tissues. In addition, some of these species can also transform less toxic compounds into more toxic compounds within their bodies. Because high risk areas are prone to chronic exposure to toxin (annual bloom events) and higher toxicities than other areas, species like surf clams, razor clams, and whole or roe-on scallops grown in these areas require testing year-round even when phytoplankton blooms are no longer in the water. Scallop adductor muscles do not accumulate toxin and are exempt from biotoxin testing requirements as long as adductor muscles are the sole product.

Requirements for biotoxin testing of high risk species through the MOU process include:

- Annual DMR biotoxin MOU signed by lease holder and DMR
- Annual private lab MOU signed by lease holder, private lab, and DMR
- Written notification 30 days prior to initial harvest
- Collect and provide samples according to DMR sampling protocols and chain of custody requirements, results provided to DMR directly from private lab
- Results from three samples each seven days apart to initiate harvest
- Written permission provided by DMR to allow initial harvest
- Sampling thereafter in consultation with DMR and at established frequencies (see Figure 2.)

Species included in DMR's routine monitoring practices (non-high risk):

1. Blue mussels: *Mytilus edulis*
2. Soft shelled clams: *Mya arenaria*
3. Hard clams/quahogs: *Mercenaria mercenaria*
4. American oysters: *Crassostrea virginica*
5. European oysters: *Ostrea edulis*

DMR has established coast-wide sampling stations used to monitor the above species on a routine basis. Sampling of these species provides the data used for closures of wild harvest and aquaculture. Aquaculture lease (standard and experimental) holders may conduct lease-specific sampling through the MOU process. Additional testing at the industry's expense can provide additional harvesting opportunities or initiate earlier re-openings by occurring at a higher frequency than DMR routine monitoring.

Requirements for biotoxin testing of non-high risk species through the MOU process include:

- Annual DMR biotoxin MOU signed by lease holder and DMR
- Optional annual private lab MOU signed by lease holder, private lab, and DMR
- Collect and provide samples according to DMR sampling protocols and chain of custody requirements
- Written permission provided by DMR to allow harvest
- Sampling thereafter in consultation with DMR and at established frequencies (see Figure 2.)
- When toxin approaches regulatory limits, lease holder has the option of following the private lab MOU process described above

Figure 2. Biotoxin Testing Strategy for Aquaculture Flow Chart

