Massachusetts Biotoxin Monitoring Program

Massachusetts Division of Marine Fisheries

Shellfish Sanitation and Management Program

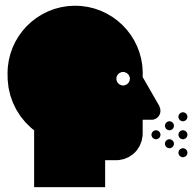
Melissa Campbell

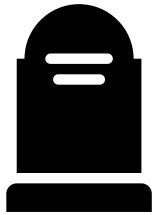
Gulf of Maine Symposium

April 8-9, 2025

GOAL: PROTECT PUBLIC HEALTH

- Shellfish are delicious!
- Shellfish are filter feeders
  - Can accumulate toxins produced by phytoplankton
  - Potential to cause illness, injury, and/or death.





MASSACHUSETTS
MARINE BIOTOXIN MANAGEMENT
&
CONTINGENCY PLAN

2024 UPDATE

Christian Petitpas
&
Jeff Kennedy (retired) Mike Hickey (retired)
With contributions from many Shellfish Program staff

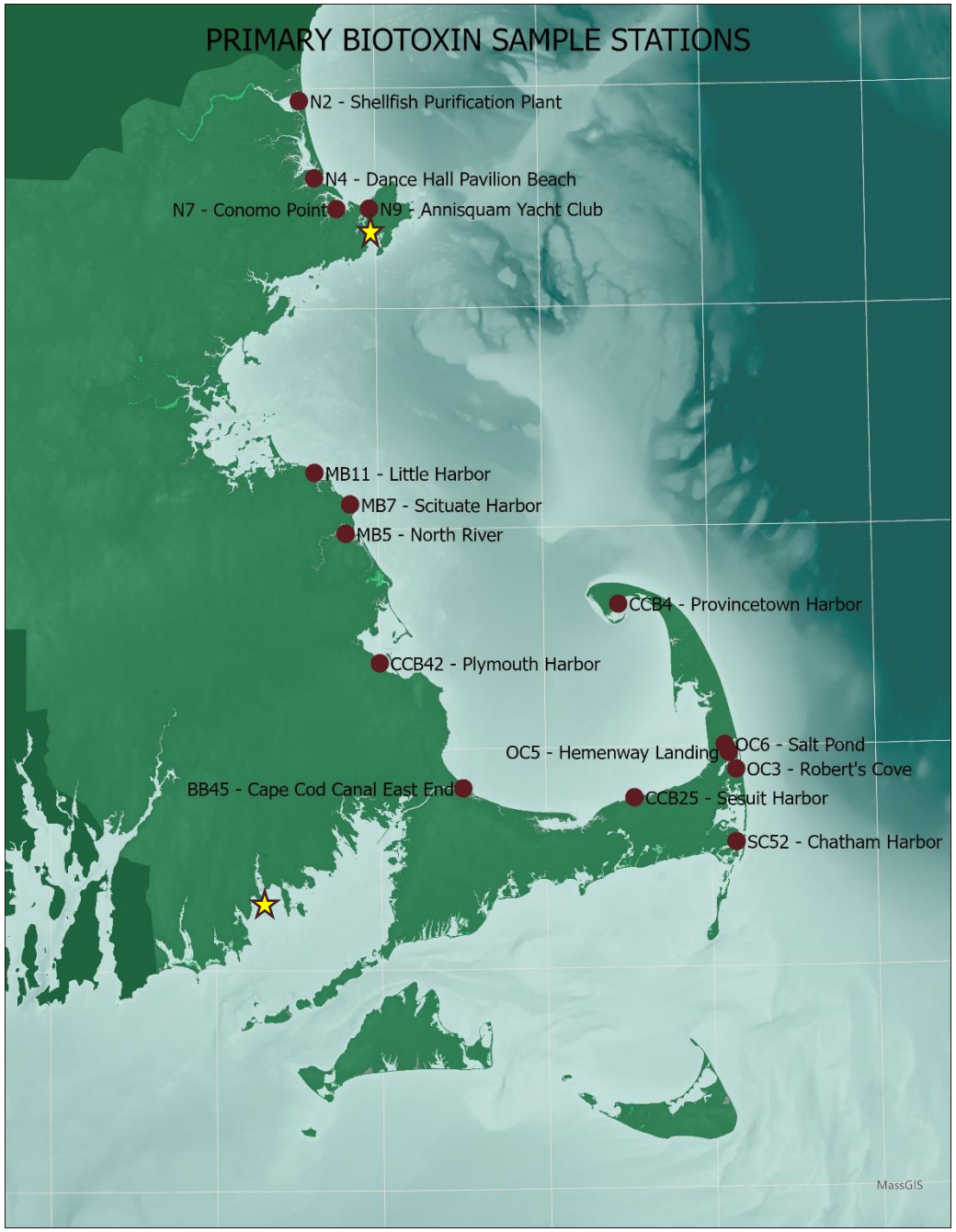
Shellfish Sanitation & Management Program

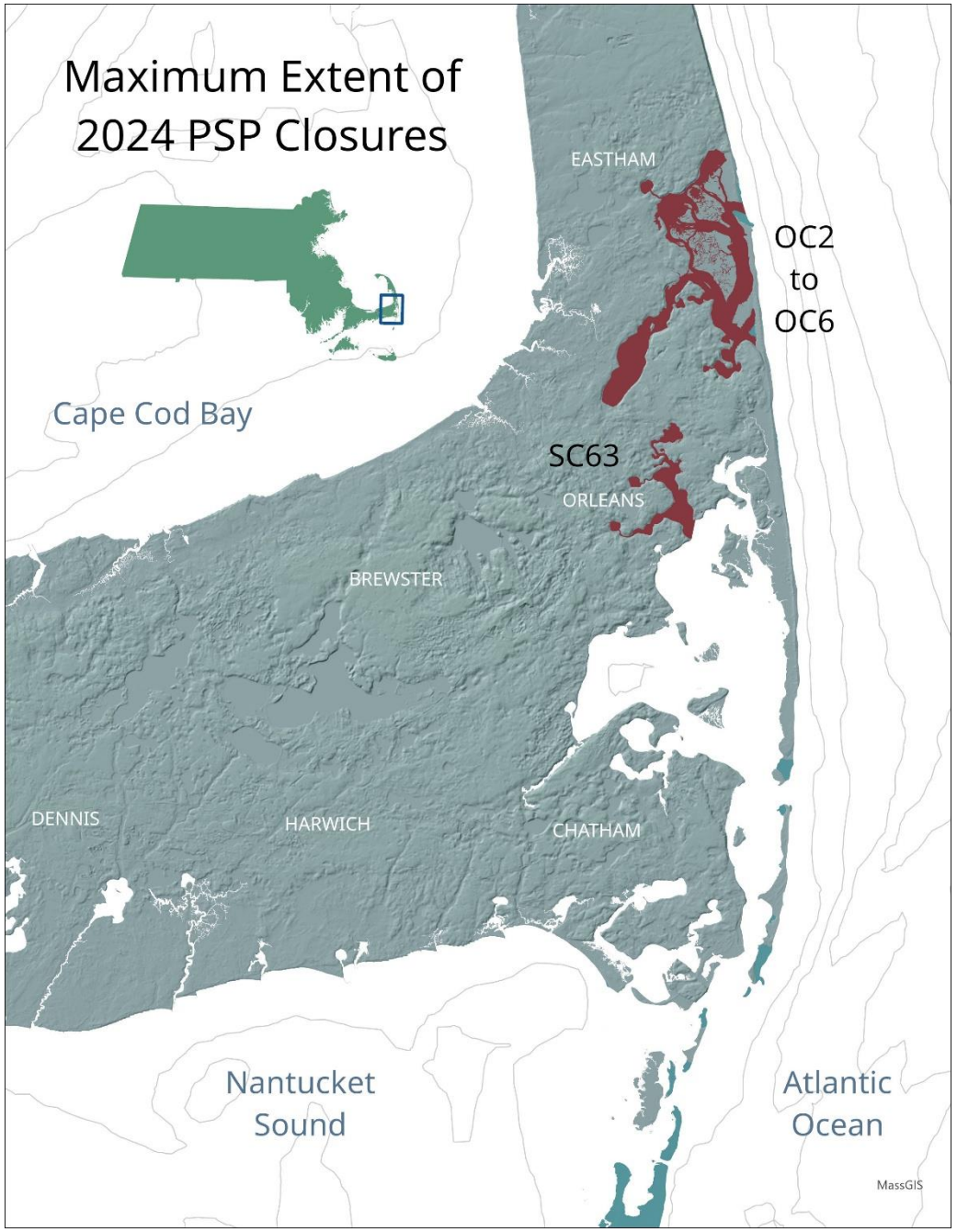
COMMONWEALTH OF MASSACHUSETTS
DIVISION OF MARINE FISHERIES

National Shellfish Sanitation Program (NSSP)

Guide for the Control of Molluscan Shellfish 2023 Revision

From the U.S. Food and Drug Administration website
https://www.fda.gov/nssp


PRIMARY BIOTOXIN SAMPLE STATIONS
N2 - Shellfish Purification Plant
N4 - Dance Hall Pavilion Beach
N7 - Conomo Point
N9 - Annisquam Yacht Club
MB11 - Little Harbor
MB7 - Scituate Harbor
MB5 - North River
CCB4 - Provincetown Harbor
CCB42 - Plymouth Harbor
OC5 - Hemenway Landing
OC6 - Salt Pond
OC3 - Robert's Cove
BB45 - Cape Cod Canal East End
CCB25 - Sesuit Harbor
SC52 - Chatham Harbor
MassGIS


Maximum Extent of
2024 PSP Closures
EASTHAM
OC2
to
OC6
Cape Cod Bay
SC63
ORLEANS
BREWSTER
DENNIS
HARWICH
CHATHAM
Nantucket
Sound
Atlantic
Ocean
MassGIS

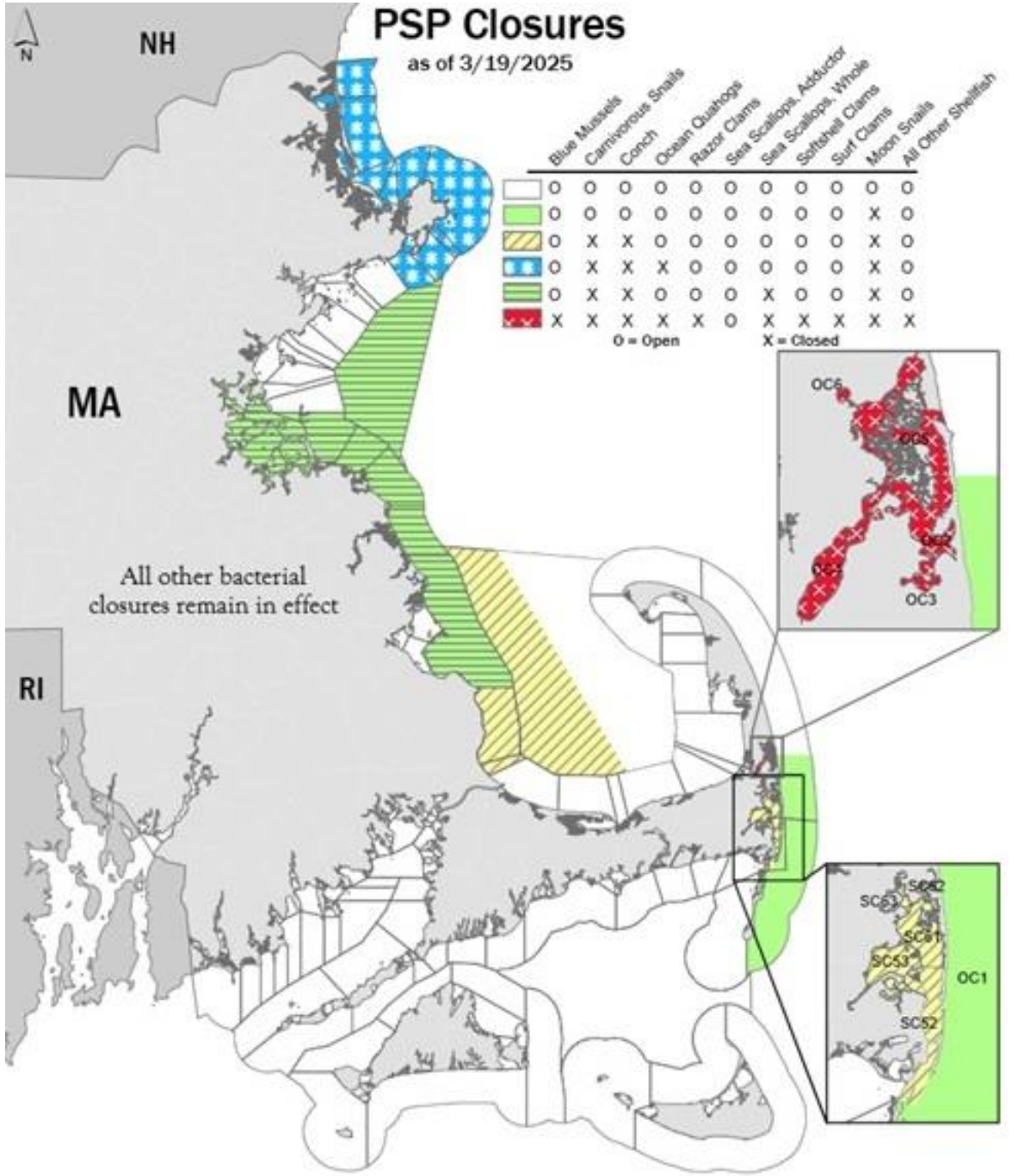
HAB Response Thresholds and Biotoxin Action Levels

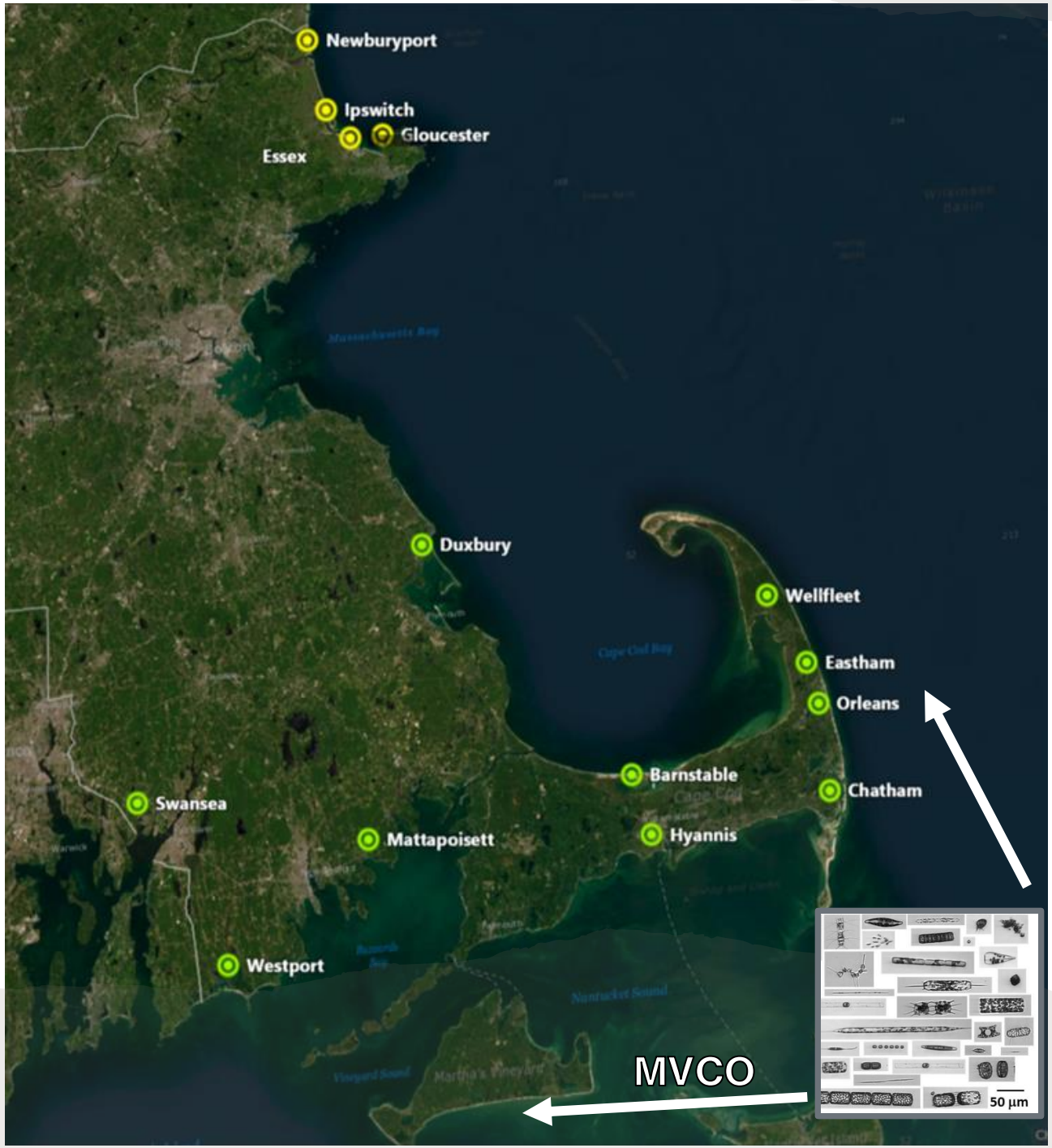
Genus/Species	Primary Toxin Family	Poisoning Syndrome	Cell Concentrations that trigger increased phytoplankton monitoring frequency	Cell Concentrations that trigger toxin screening	Shellfish meat sample toxin concentrations that trigger precautionary closure[3]	Shellfish meat toxin concentrations requiring mandatory closure and product recall	Reopening Criteria
Alexandrium catenella	Saxitoxin	PSP	100 cells/liter	500 cells/liter (species ID from WHOI?)	40-79 µg/100g	80 µg/100g (0.8 ppm)	3 consecutive declining samples below 80 µg/100g over ≥ 14 days
Pseudo-nitzschia spp.	Domoic acid	ASP	30K cells/liter	30K cells/liter	1-1.9 mg/100g	2 mg/100g (20 ppm)	3 consecutive declining samples below 20 ppm over ≥ 14 days
Dinophysis sp.	Okadaic acid	DSP	50K cells/liter	100K cells/liter	0.08 – 0.15 mg/kg	0.16 mg/kg (0.16 ppm)	2 consecutive declining samples below 0.16 ppm over ≥ 14 days
Prorocentrum lima	Okadaic acid	DSP	1K cells/liter	10K cells/liter	0.08 – 0.15 mg/kg	0.16 mg/kg (0.16 ppm)	3 consecutive declining samples below 0.16 ppm over ≥ 14 days
Karenia papillionacea	Brevetoxins	NSP	1K cells/liter	5K cells/liter	0.4-0.7 mg/kg	20 MU/100g or 0.8 mg/kg (0.8 ppm)	3 consecutive declining samples below 20 MU/100 g over ≥ 14 days
Karenia brevis[4]	Brevetoxins	NSP	1K cells/liter	5K cells/liter	0.4-0.7 mg/kg	20 MU/100g or 0.8 mg/kg (0.8 ppm)	3 consecutive declining samples below 20 MU/100 g over ≥ 14 days
Azadinium sp.[5]	Azaspiracid	AZP	1 Million cells/liter	5 Million cells/liter	0.08 – 0.15 mg/kg	0.16 mg/kg (0.16 ppm)	3 consecutive declining samples below 0.16 ppm over ≥ 14 days

4. Massachusetts has no confirmed history of Karenia brevis

5. Massachusetts has no confirmed history of Azadinium.

CURRENT MASSACHUSETTS PSP CLOSURE MAP





Quantitative Harmful Algae Monitoring

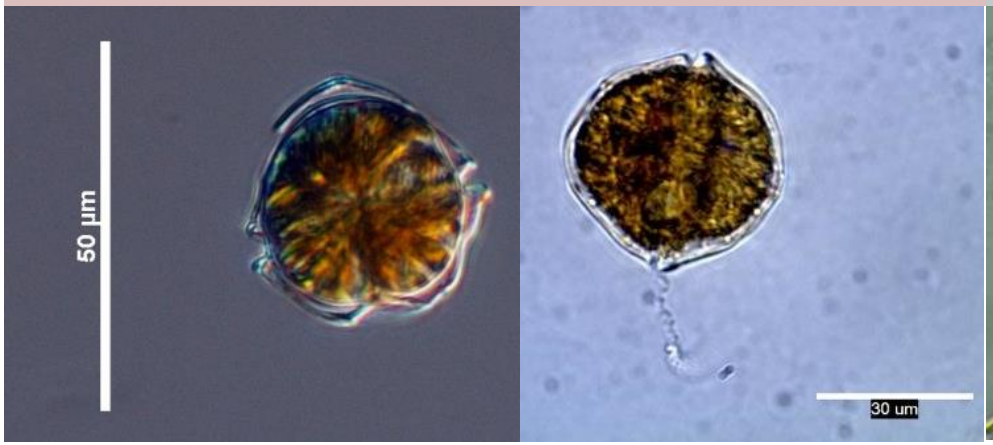
4 North Shore & 10 South Shore

- Added 2 primary stations to South Shore monitoring (Orleans + Chatham)
- Year-round sampling at each station
  4 Weekly for NS, 5 Bi-weekly for SS
- Roughly 600 samples per year
- Obtained AquaBC kits for ASP, DSP, and PSP
  For tissue and phyto concentrations

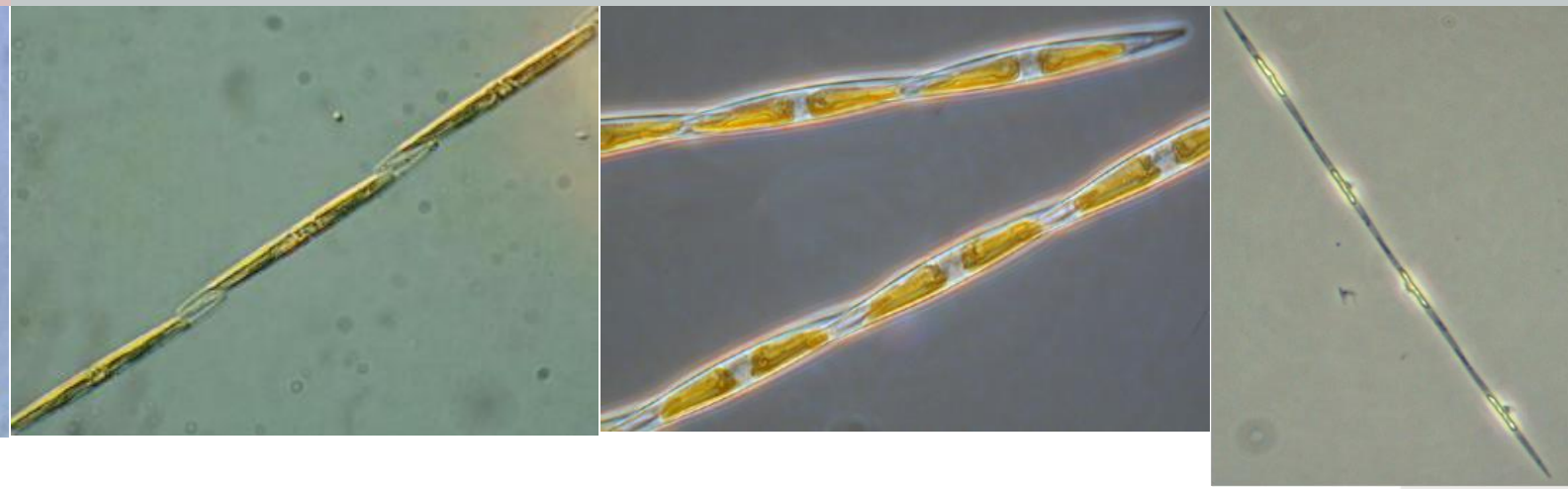
WHOI imaging flow cytobots (IFCBs) supplement DMF monitoring.

POTENTIALLY TOXIC HARMFUL ALGAE KNOWN IN REGION

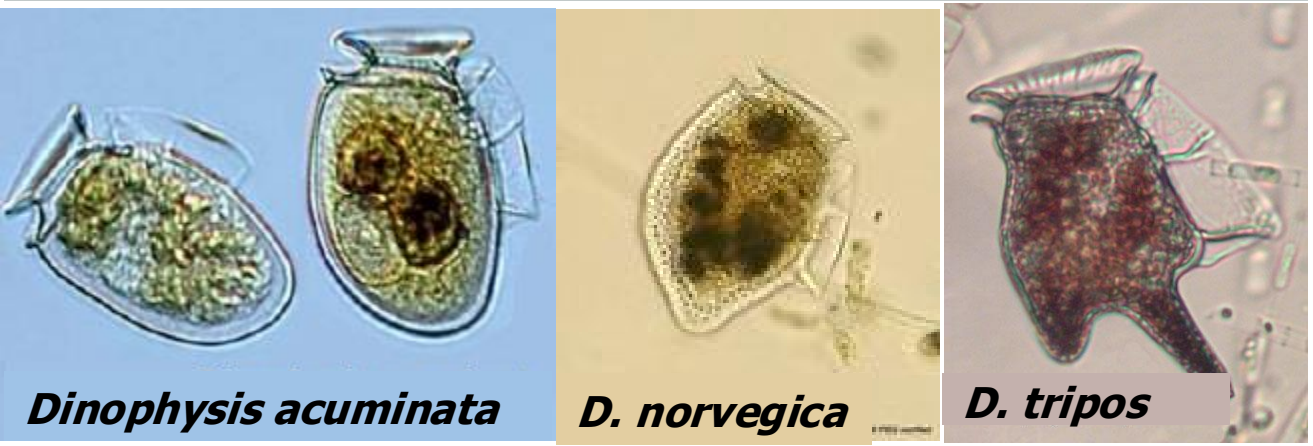
Alexandrium spp. (saxitoxins/PSP)



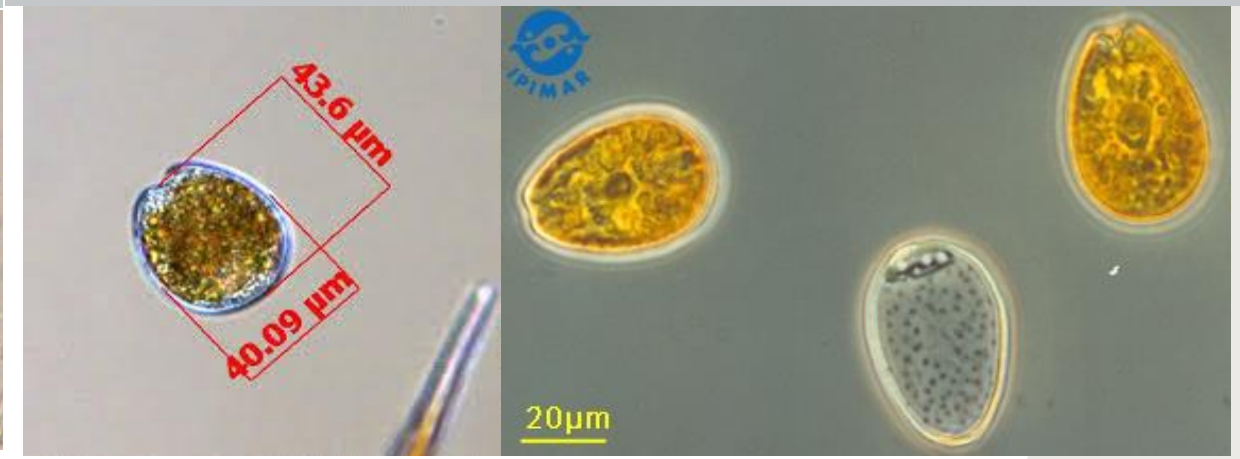
Pseudo-nitzschia spp. (domoic acid/ASP)



Dinophysis spp. (okadaic acid; dinophysistoxins/DSP)



Prorocentrum lima (okadaic acid;dinophysistoxins/DSP)



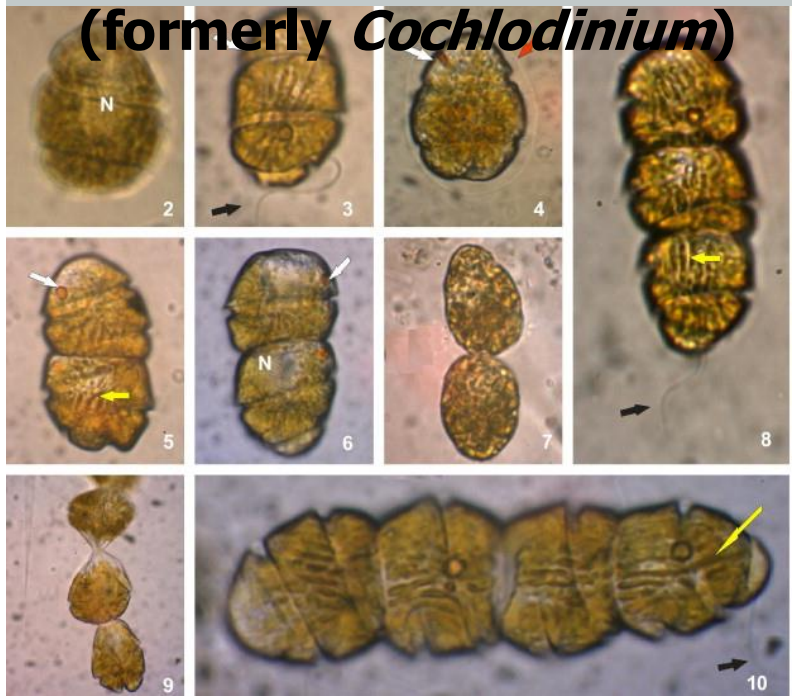
Benthic/epiphytic, but can be found in water column

HARMFUL ALGAE TOXIC TO SHELLFISH/FISH

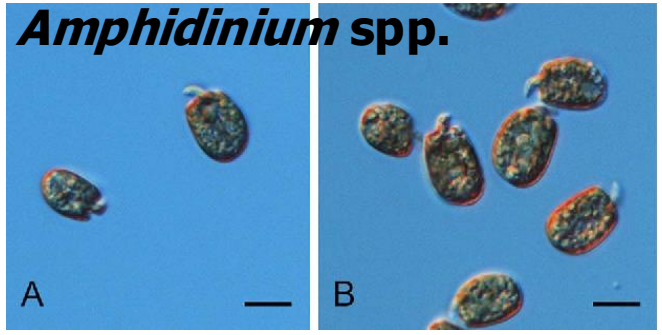
(Not public health concern… that we know of)

RUST TIDE

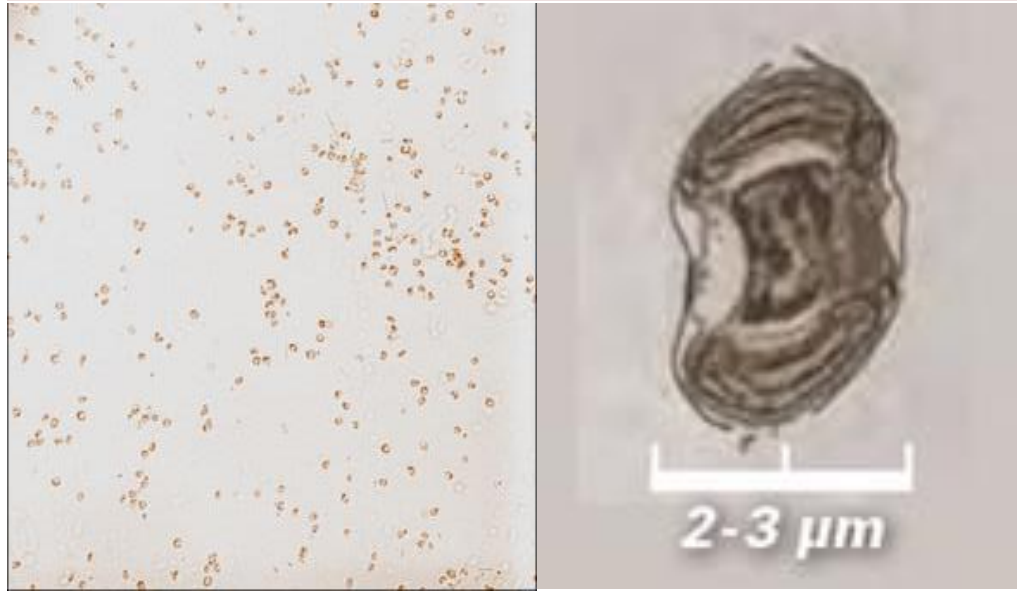
Margalefidinium polykrikoides (formerly *Cochlodinium*)



Amphidinium spp.

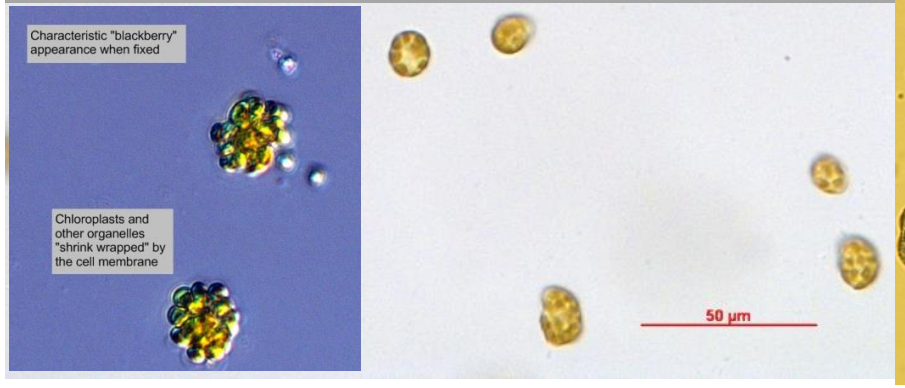


Aureococcus anophagefferens

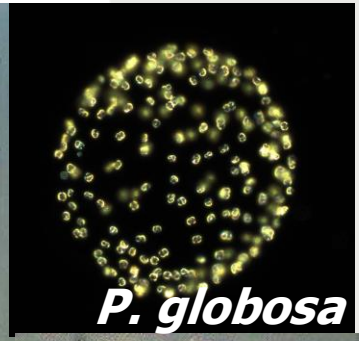


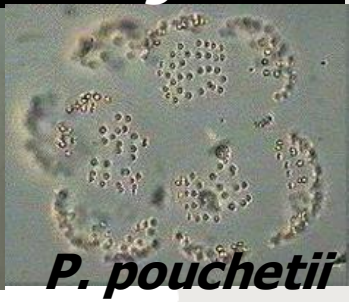
BROWN TIDE

Heterosigma akashiwo

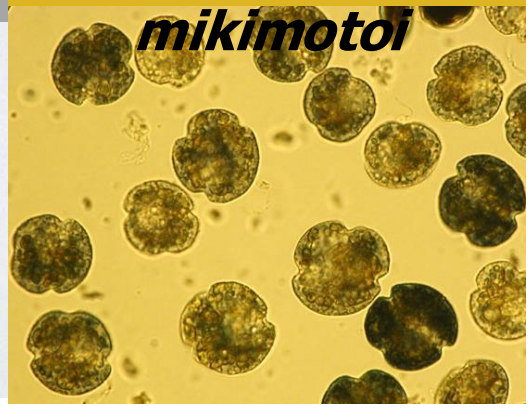


Phaeocystis spp.

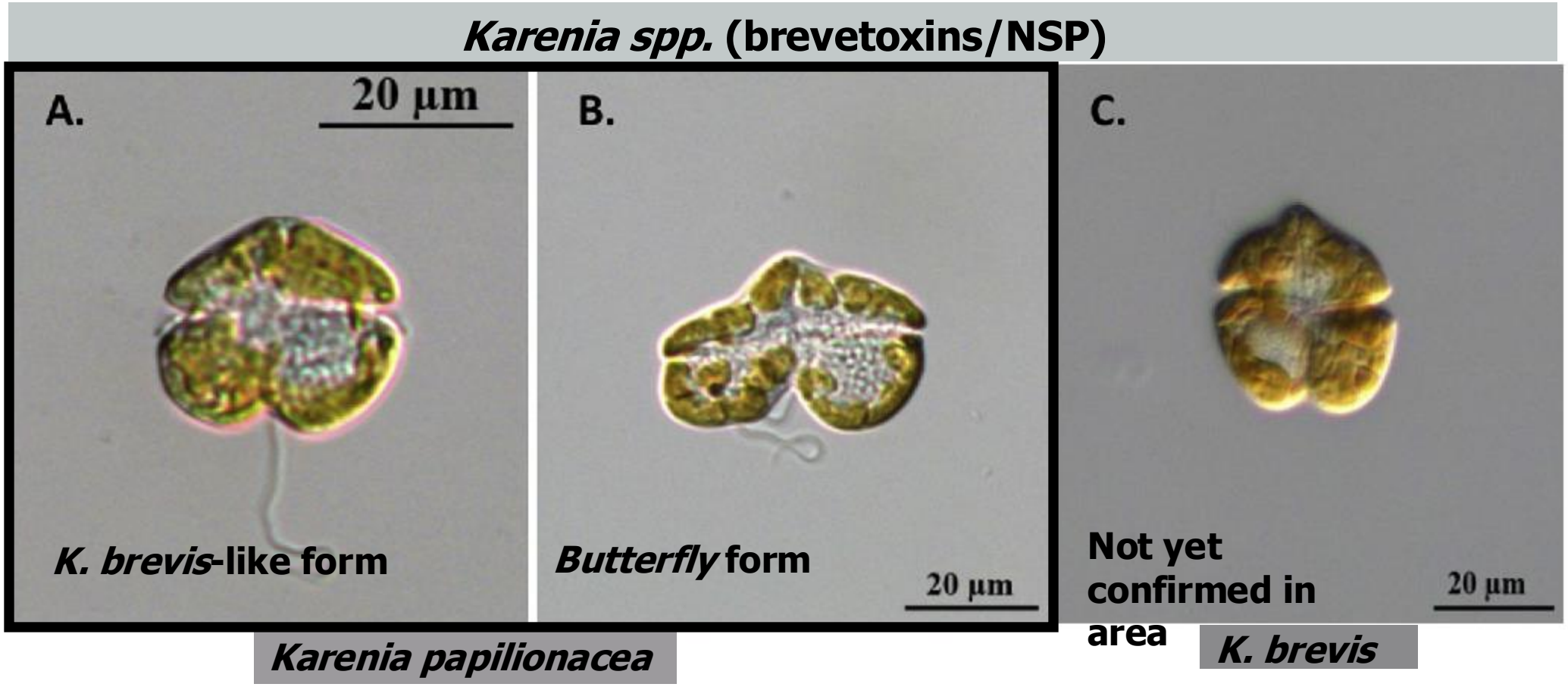




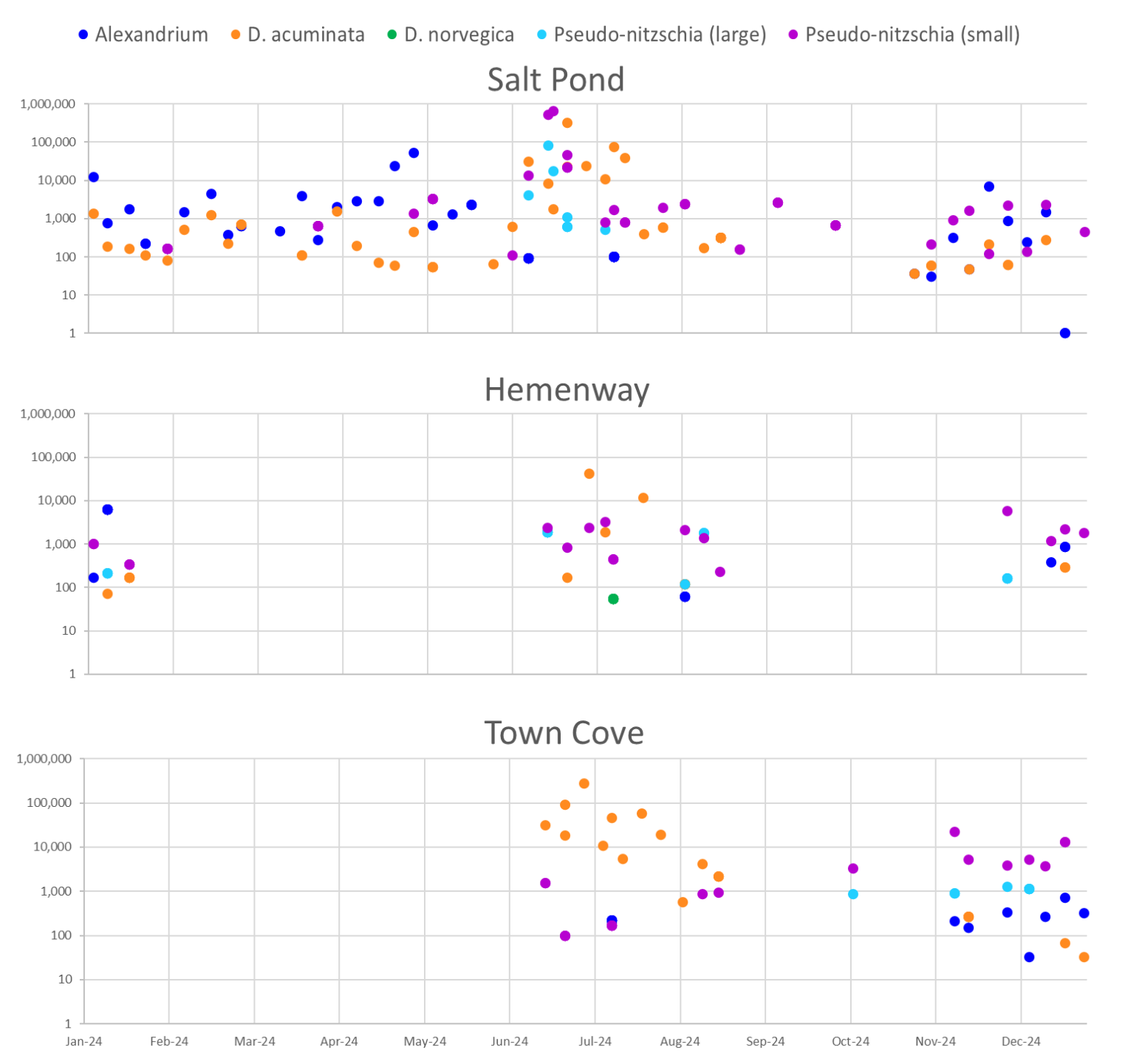
Karenia mikimotoi



POTENTIALLY TOXIC HARMFUL ALGAE RECENTLY FOUND IN REGION

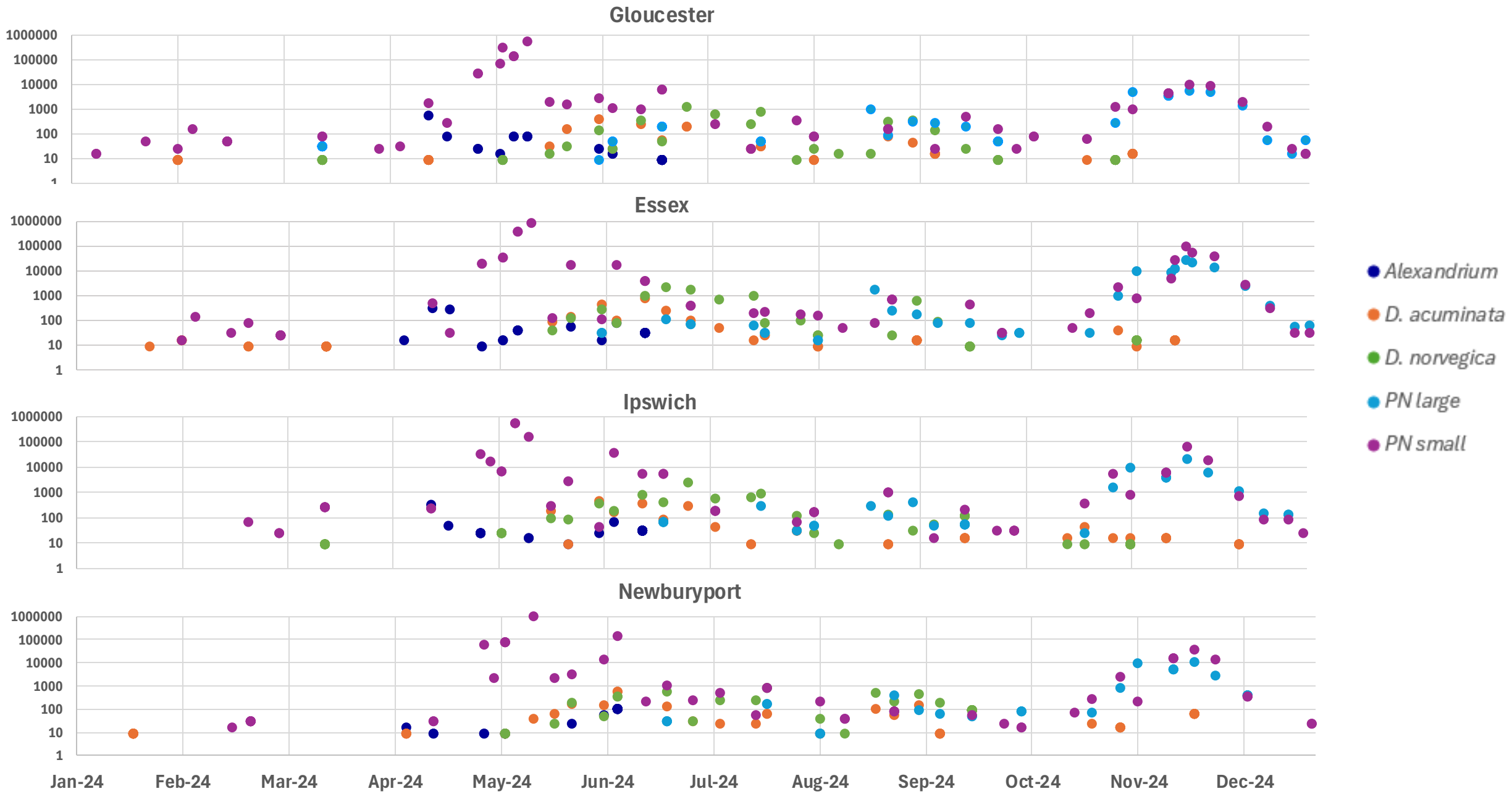


Bloom of *K. papilionacea* in Buzzards Bay (Westport River) in October of 2021. *K. papilionacea* has two different cell forms, a large and small cell. Both are very similar to *K. brevis* and have been observed in the same bloom. The larger butterfly form has a pronounced hypothecal excavation (Haywood et al. 2004) and has been shown to contract horizontally allowing the left and right sides to almost touch, similar to a butterfly flapping its wings.


Alexandrium
D. acuminata
D. norvegica
Pseudo-nitzschia (large)
Pseudo-nitzschia (small)
Salt Pond
1,000,000
100,000
10,000
1,000
100
10
1
Hemenway
1,000,000
100,000
10,000
1,000
100
10
1
Town Cove
1,000,000
100,000
10,000
1,000
100
10
1
Jan-24
Feb-24
Mar-24
Apr-24
May-24
Jun-24
Jul-24
Aug-24
Sep-24
Oct-24
Nov-24
Dec-24

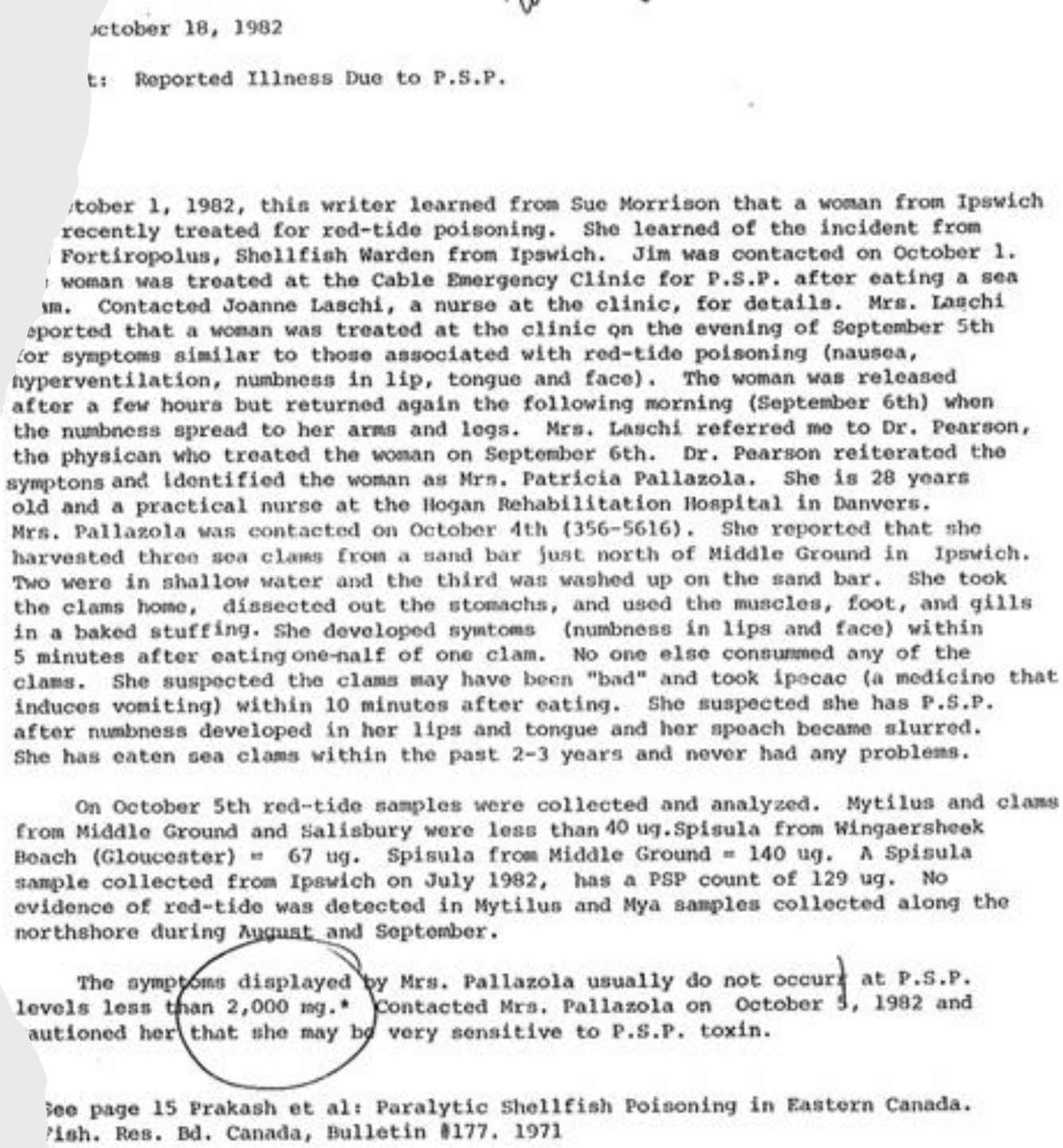

Salt Pond
Hemenway
Town Cove
Roberts Cove
Nauset System

North Shore Phytoplankton Monitoring



1972 1982 1987 2002

- 1972 – Start of annual PSP in MA
- 1982 – Reported illness due to PSP
- 1987 – 14 humpback whales dead from PSP
- 2002 – Red water in Westport river



ctober 18, 1982

t: Reported Illness Due to P.S.P.

tober 1, 1982, this writer learned from Sue Morrison that a woman from Ipswich recently treated for red-tide poisoning. She learned of the incident from Fortiropolus, Shellfish Warden from Ipswich. Jim was contacted on October 1. woman was treated at the Cable Emergency Clinic for P.S.P. after eating a sea am. Contacted Joanne Laschi, a nurse at the clinic, for details. Mrs. Laschi eported that a woman was treated at the clinic on the evening of September 5th for symptoms similar to those associated with red-tide poisoning (nausea, hyperventilation, numbness in lip, tongue and face). The woman was released after a few hours but returned again the following morning (September 6th) when the numbness spread to her arms and legs. Mrs. Laschi referred me to Dr. Pearson, the physican who treated the woman on September 6th. Dr. Pearson reiterated the symptons and identified the woman as Mrs. Patricia Pallazola. She is 28 years old and a practical nurse at the Hogan Rehabilitation Hospital in Danvers. Mrs. Pallazola was contacted on October 4th (356-5616). She reported that she harvested three sea clams from a sand bar just north of Middle Ground in Ipswich. Two were in shallow water and the third was washed up on the sand bar. She took the clams home, dissected out the stomachs, and used the muscles, foot, and gills in a baked stuffing. She developed symtoms (numbness in lips and face) within 5 minutes after eating one-half of one clam. No one else consummed any of the clams. She suspected the clams may have been "bad" and took ipecac (a medicine that induces vomiting) within 10 minutes after eating. She suspected she has P.S.P. after numbness developed in her lips and tongue and her speach became slurred. She has eaten sea clams within the past 2-3 years and never had any problems.

On October 5th red-tide samples were collected and analyzed. Mytilus and clams from Middle Ground and Salisbury were less than 40 ug. Spisula from Wingaersheek Beach (Gloucester) = 67 ug. Spisula from Middle Ground = 140 ug. A Spisula sample collected from Ipswich on July 1982, has a PSP count of 129 ug. No evidence of red-tide was detected in Mytilus and Mya samples collected along the northshore during August and September.

The symptoms displayed by Mrs. Pallazola usually do not occur at P.S.P. levels less than 2,000 mg.* Contacted Mrs. Pallazola on October 5, 1982 and autioned her that she may be very sensitive to P.S.P. toxin.

ee page 15 Prakash et al: Paralytic Shellfish Poisoning in Eastern Canada. ish. Res. Bd. Canada, Bulletin #177. 1971

2005

boston.com

THIS STORY HAS BEEN FORMATTED FOR EASY PRINTING

Red menace

The Boston Globe

Scientists are just beginning to understand the algae blooms that have closed shellfish beds from Maine to Martha's Vineyard

By Carolyn Y. Johnson, Globe Staff | June 14, 2005

As state officials scramble for disaster relief for shellfishermen strapped by the worst bloom of red tide in decades, scientists are trying to figure out whether the toxic algae explosion hints at an ecological disaster.

boston.com

THIS STORY HAS BEEN FORM

Romney declares red tide a disaster for Massachusetts

By Theo Emery, Associated Press Writer | June 9, 2005

BOSTON --Gov. Mitt Romney on Thursday declared a state of emergency because of the red t
of Massachusetts, allowing the state to seek federal disaster aid for the shellfish industry.

"I have declared a state of emergency, and am seeking disaster relief," he said.

Red tide is the result of algae that contaminate shellfish and can be dangerous to humans who
not pose a risk to people who eat lobsters or finned fish.

The red tide bloom that has advanced southward from Maine over the past two months is the w
since 1972. Thursday marked the first time Massachusetts has declared a state of emergency
although other regions of the country have sought federal aid for that reason.

Romney said he is seeking aid from both the U.S. Small Business Administration and the Depa
shellfisherman and others affected by the red tide.

He said red tide is costing the shell fish industry about $3 million per week. He said he didn't kn
take to get a response from the government, but said the request is being expedited.

Posted on Mon, Jun. 06, 2005

Vast red tide ravages New England's shellfish waters

By Robert Lee Hotz
Los Angeles Times

The worst toxic red tide in a generation is contaminating dozens of major shellfish beds in New England, prompting fishery closures from Maine to Nantucket, Mass., where clams, mussels and ba
scallops are the coastal communities' commercial lifeblood.

An unusually intense plankton bloom more than 30 miles wide in places continued to spread over th
weekend, driven by wind and currents into areas that had never known such infestations before.

The outbreak might peak in another week, officials said. It might be a month or more, however, befo
the region, which exports quahog clams and other sea fare around the world, can safely resume sh
fishing.

Fishermen in the oyster- and clam-rich centers of Cape Cod, Mass., are out of work, and fish mar
and restaurants on the cape are scrambling to find substitutes, and, in turn, selling the more expe
fish at higher-than-usual prices.

Herald.com

Many see red over tide

By Ann E. Donlan
Saturday, June 11, 2005 - Updated 06:58 AM EST

As the most stubborn red tide in 33 years gripped the Bay State coastline and paralyzed the livelihoods of 1,7
relief, clam diggers left the flats in search of odd jobs and worried restaurateurs reassured customers their she
"In the winter, you've got to deal with the cold, and the spring and fall, it's rain closures, and the summer is
44. "So when we're denied that for red tide, it hurts. I live paycheck to paycheck."

Gov. Mitt Romney asked President Bush to declare an emergency yesterday. Also, the state's congressiona
Department of Commerce to help deliver relief for fishermen, businesses and communities suffering from the d
million, and the red invasion is not expected to retreat for a month.

Newsday.com

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Red tide continues spread down New England coast

By JAY LINDSAY
Associated Press Writer

June 2, 2005, 3:40 PM EDT

BOSTON -- One of New England's worst "red tides" in decades continued its southward expansion this week, rounding Cape Cod and forcing the closure of some of the region's most prolific shellfish beds.

The toxic algae bloom began in the waters off Maine last month and spread quickly. It had already shut down shellfish beds as far north as New Hampshire. On Thursday, Massachusetts officials closed the highly productive flats of the Monomoy Natural Wildlife Refuge, off Chatham, to shellfishermen. About half the state's shellfish beds are now closed.

For the first time ever, the red tide also traveled through the Cape Cod Canal into Buzzards Bay, but it's unlikely to have any impact on summer beachgoers on the Cape and elsewhere, experts

Ipswich Chronicle
on TOWNONLINE.com

Clam flats remain closed

By Faith Tomei/ ftomei@cnc.com
Thursday, June 16, 2005

Ipswich is on the map these days with the news media, from theNew York Times to network TV. Politicians, from Gov. Mitt Romney to U.S. Sen. John Kerry, are focusing attention on the town. That's because Ipswich is known for its clams, and clams aren't being harvested.

The clam flats have been shut down by the state since May 20, when marine biologists declared the North Shore shellfish contaminated by the red tide algae bloom. This is the worst red tide outbreak since 1972, when the red tide closed clam flats for most of the summer.

Most clammers in Ipswich are too young to remember 1972, though Shellfish Constable Phil Kent, now 81, had a hard time that year when he was a full-time clammer supporting a family. "It was pretty bad," he said.

Kent sympathizes with the commercial clammers this year, but he takes his current job seriously. He posted signs closing the clam flats immediately. Since then, he's been sending shellfish samples which are tested by marine biologists at Annisquam River Marine Fisheries Station in Gloucester.

Ipswich Shellfish Constable Phil Kent has posted signs warning of clam flat closures at Eagle Hill Landing and other places where clammers launch boats and head to the flats. (Photo By Faith Tomei)

The Register

Shellfish industry battles red tide of bad publicity

By Craig Salters/ csalters@cnc.com
Thursday, June 23, 2005

For Roger Cahoon, owner of Seven C's Fish Market in West Yarmouth, Father's Day weekend is traditionally a busy one, with shellfish sales in the range of 13 to 15 bushels.

This year, because of red tide fears, those sales numbers were down by 13 to 15 bushels.

"This past weekend I didn't sell one bushel," said Cahoon, who said overall shellfish sales were down a jaw-dropping 95 percent since red tide, a naturally occurring toxic algal bloom, first hit Cape waters.

But it hasn't hit all Cape waters, a fact which frustrates Cahoon and those like him who must deal with both the reality of a serious red tide event and the misperception that all local shellfish is somehow off-limits.

It's not. Although red tide has closed shellfish beds from Maine to Nantucket, including Cape Cod Bay and Barnstable Harbor, the entire south side of Cape Cod, from the Chatham/Harwich line to the Elizabeth Islands in Buzzards Bay, is open for business.

"It [red tide] is not in the sound," said Cahoon, who has a small sign telling customers as much in his Route 28 store. The open shellfish beds, Cahoon added, are tested daily and have come up "100 percent safe."

David Johnson does some shellfishing Monday at Follins Pond. The current red tide event is the worst in Massachusetts history but has left the south side of Cape Cod unaffected. (Staff photo by Craig Salters)

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June 4, 2005

Red tide shuts island beds

By DOUG FRASER
STAFF WRITER

Opportunities to buy and sell shellfish in Massachusetts have now narrowed to just a few ports. Hard on the heels of the closure Thursday of one of the state's most productive areas, Monomoy Island and an adjacent area known as the Southway, the state Division of Marine Fisheries yesterday closed the rest of Chatham and all of Nantucket.

The toxin concentrations found in blue mussels in the Nantucket Harbor inlet was 333 micrograms per 100 grams of shellfish meat, four times the legal limit. DMF chief shellfish biologist Michael Hickey said the contamination happened overnight since Nantucket shellfish showed no algae toxins in tests Thursday.

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News

Fried by red tide

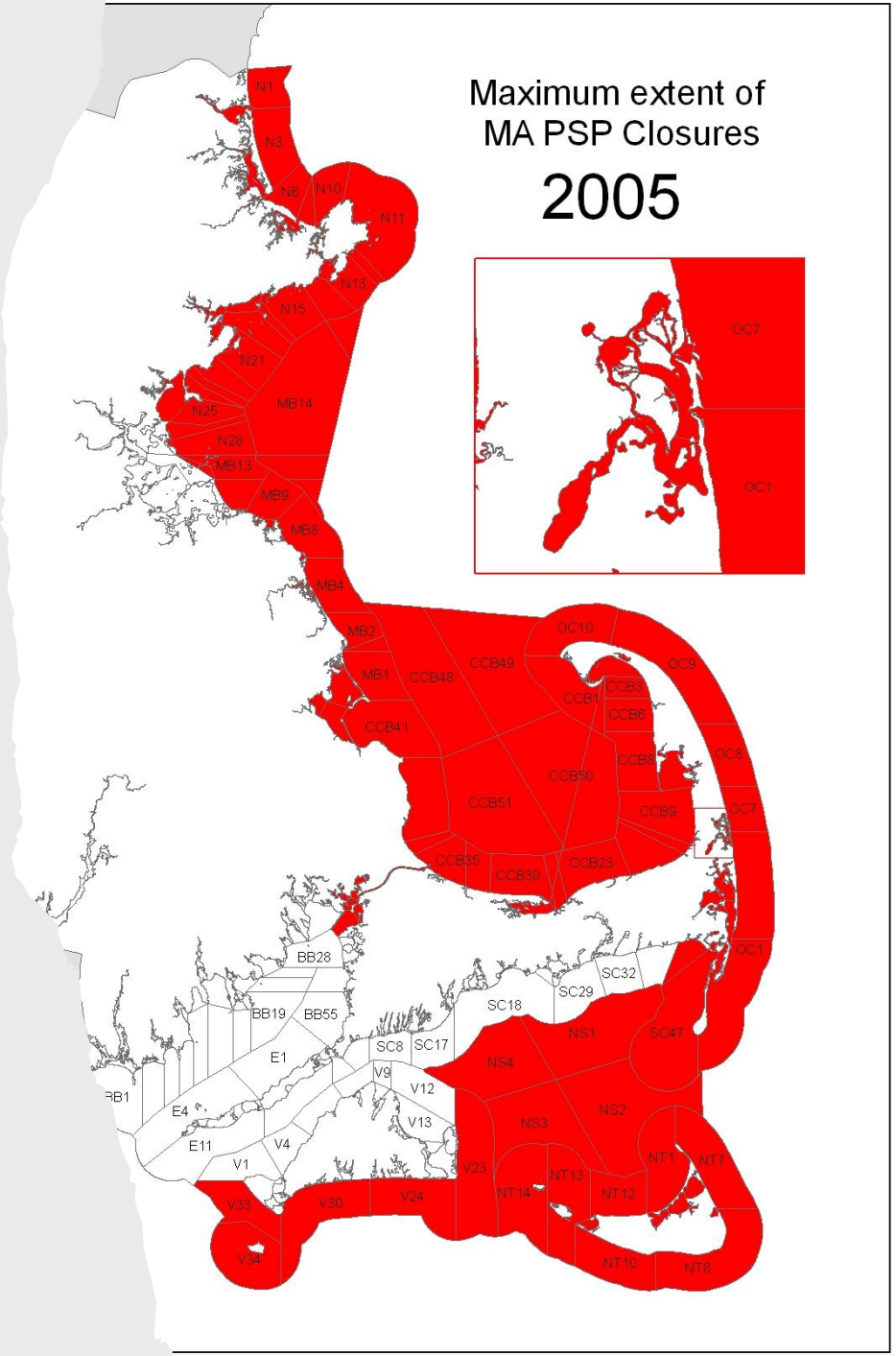
The red tide has shut down clam flats throughout the state causing a rise in price in places like The Cupboard in Stage Fort Park, where Hudson Carter is a fry cook. Photo by Jessica Stygles/Gloucester Daily Times

By Patricia Cronin
Staff writer

The baleful bloom of the toxic algae known as red tide that spread down the state's coast and prompted the closure of shellfish flats as far north as the New Hampshire border and as far south as Cape Cod Friday could mean increased prices for fried clams and other summer favorites.

2005

Declared a fisheries disaster due to economic impact.



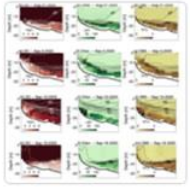
2013 2015 2016 2017 2019 2020 2021 PRESENT

- 2013 – Quantitate phytoplankton sampling began
- 2015 – DSP closure
- 2016 – *Pseudo-nitzschia* bloom and closures in southern MA
- 2017 – *Karenia mikimoitoi* bloom
- 2017 – Year-round phytoplankton sampling began
- 2019/2020 – *Karenia mikimoitoi* bloom in Cape Cod Bay causes lobster mortality
- 2021- Bloom of *K. papilionacea*
- Present – Alexandrium cells observed in November, December, January.
- HABs are changing in unpredictable ways and making management more difficult

Research article | CC BY

28 Jul 2022

Unprecedented summer hypoxia in southern Cape Cod Bay: an ecological response to regional climate change?



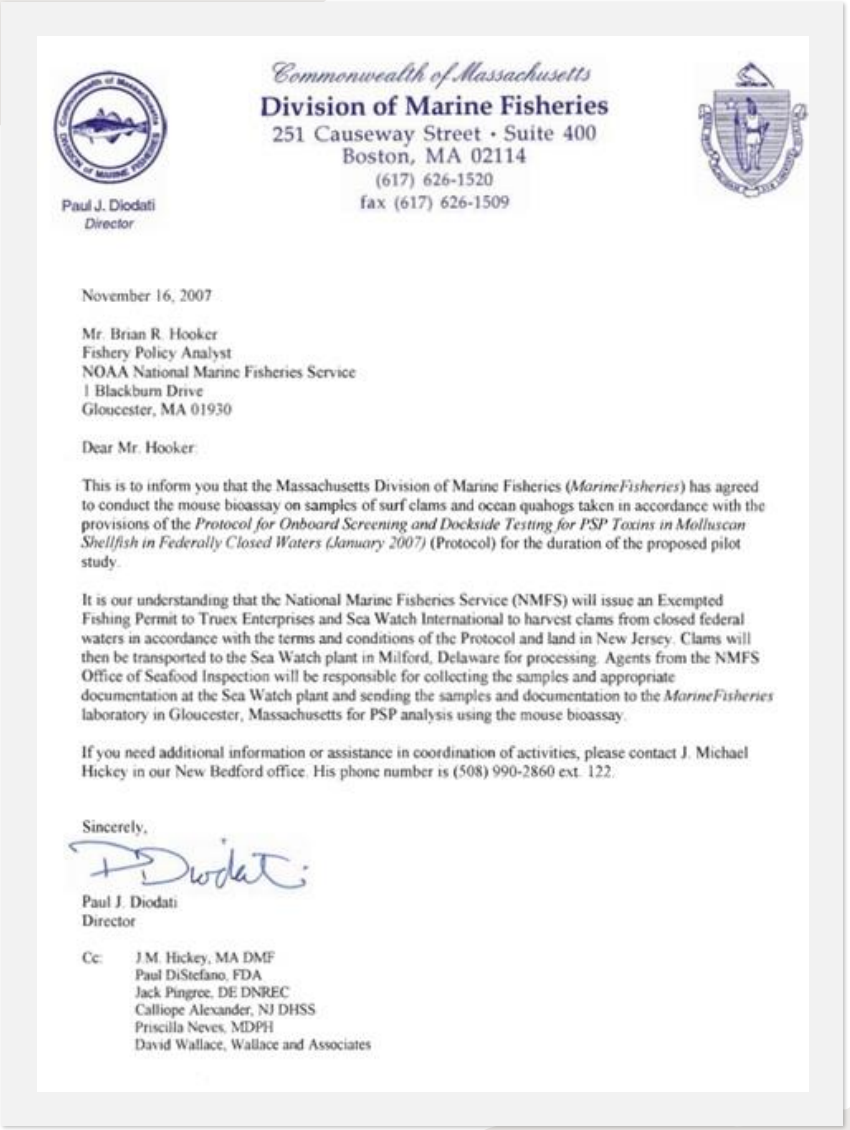
Malcolm E. Scully, W. Rockwell Geyer, David Borkman, Tracy L. Pugh, Amy Costa, and Owen C. Nichols

Abstract

In late summer 2019 and 2020 bottom waters in southern Cape Cod Bay (CCB) became depleted of dissolved oxygen (DO), with documented benthic mortality in both years. Hypoxic conditions formed in relatively shallow water where the strong seasonal thermocline intersected the sea floor, both limiting vertical mixing and concentrating biological oxygen demand (BOD) over a very

PAST AND CURRENT PARTNERSHIPS

- Dockside testing
- Saving homogenate for Bigelow
- Letters of support
- Data sharing and cooperation with other New England states
- Gloucester Marine Genomics Institute (GMGI)



Commonwealth of Massachusetts
Division of Marine Fisheries
251 Causeway Street • Suite 400
Boston, MA 02114
(617) 626-1520
fax (617) 626-1509

Paul J. Diodati
Director

November 16, 2007

Mr. Brian R. Hooker
Fishery Policy Analyst
NOAA National Marine Fisheries Service
1 Blackburn Drive
Gloucester, MA 01930

Dear Mr. Hooker:

This is to inform you that the Massachusetts Division of Marine Fisheries (*MarineFisheries*) has agreed to conduct the mouse bioassay on samples of surf clams and ocean quahogs taken in accordance with the provisions of the *Protocol for Onboard Screening and Dockside Testing for PSP Toxins in Molluscan Shellfish in Federally Closed Waters (January 2007)* (Protocol) for the duration of the proposed pilot study.

It is our understanding that the National Marine Fisheries Service (NMFS) will issue an Exempted Fishing Permit to Truex Enterprises and Sea Watch International to harvest clams from closed federal waters in accordance with the terms and conditions of the Protocol and land in New Jersey. Clams will then be transported to the Sea Watch plant in Milford, Delaware for processing. Agents from the NMFS Office of Seafood Inspection will be responsible for collecting the samples and appropriate documentation at the Sea Watch plant and sending the samples and documentation to the *MarineFisheries* laboratory in Gloucester, Massachusetts for PSP analysis using the mouse bioassay.

If you need additional information or assistance in coordination of activities, please contact J. Michael Hickey in our New Bedford office. His phone number is (508) 990-2860 ext. 122.

Sincerely,

Paul J. Diodati
Director

Cc: J.M. Hickey, MA DMF
Paul DiStefano, FDA
Jack Pingree, DE DNREC
Calliope Alexander, NJ DHSS
Priscilla Neves, MDPH
David Wallace, Wallace and Associates

HAB DATA AND OPPORTUNITIES FOR COLLABORATION

- PSP shellfish data 1972-present (just over 29k samples recorded)
  - Blue mussel, softshell clam, quahog, razor clam, surf clam, bay scallop, oyster, ribbed mussel, moon snail, sea scallop, ocean quahog, stimpsons whelk, channeled whelk, ten-ridged whelk, waved whelk.
- PSP closure notice data 1972-present
- Phytoplankton (HAB sp. Only)
  - Quantitative 2013-present

- "Boots on the ground"

DATA SHARING AND OPPORTUNITIES FOR GROWTH

Weekly Phytoplankton & Biotoxin summary email

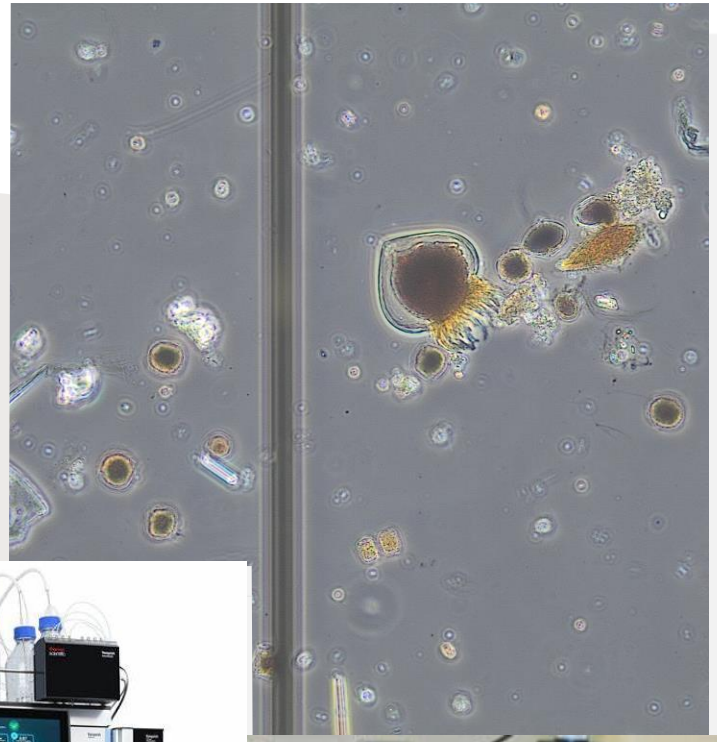
-One week delay for phytoplankton cell counts.

-Two week delay for biotoxin toxicity counts.

-Let us know if you would like to be added to the distribution list (Alyson.mello@mass.gov)

Continuing work to set up HPLC testing for PCOX to move away from MBA

New microscope with fluorescence capabilities



Questions?